



September 6, 1991

Ralph Smith
Montana Department of Health
and Environmental Sciences
Solid and Hazardous Waste Bureau
836 Front Street
Helena, MT 59601

RE: Helena Landfill Closure Plan

Dear Ralph,

Enclosed is a copy of the Helena Landfill Closure Plan submitted by the City of Helena to meet the closure requirements of the Solid and Hazardous Waste Bureau. Please review this report and call me to schedule a meeting for any questions, comments or revisions.

Sincerely,

Randy L. Huffsmith, P. E.
Hydrologist/Engineer

RLH:jy

Enclosure

c: Dick Nisbet
Ted Hill
William Verwolf

RECEIVED

SEP 06 1991

Montana Department of Health
and Environmental Sciences
Solid and Hazardous Waste Bureau

APPENDIX A.

HELENA LANDFILL AREA WATER QUALITY

Table 2.3 - SUMMARY OF HELENA LANDFILL AREA WATER QUALITY

Client: CHHL01 - City of Helena

Project: Hlna Landfill Mitng

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Sample Type: Other Sites

SITE CODE	13	13	13	19	20	23	26	28	31	31	31	31	32
SAMPLE DATE	02/16/90	05/04/90	04/04/91	05/04/90	05/06/90	05/06/90	05/03/90	06/05/90	05/03/90	05/03/90	04/13/91	05/03/90	
LAB	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	
LAB NUMBER	90-3298	90-10822	91-12763	90-10823	90-10825	90-10826	90-10817	90-15038	90-10820	90-10820	91-13088	90-10818	
REMARKS			Helena Landfi							DUPLICATE	Helena Landfi		
SAMPLE NUMBER	HYD-5710	HYD-5711	HL9104-100	HYD-5696	HYD-5779	HYD-5747	HYD-5742	HYD-5699	HYD-5750	HYD-5751	HL9104-111	HYD-5755	
-- VOLATILE ORGANICS --													
1,1,1,2-TETRACHLOROETHANE (ppb)	<1	<1		<1	<1	<1	<1	<1	<1	<1	<1	<1	
1,1,1-TRICHLOROETHANE (ppb)	0.78	0.79	0.88	<0.5	<0.5	1.9	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
1,1,2,2-TETRACHLOROETHANE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	
1,1,2-TRICHLOROETHANE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	
1,1-DICHLOROETHANE (ppb)	<1.0 *	<1.0 *	<1	<1	<1	1.1	<1	<1	<1	<1	<1	<1	
1,1-DICHLOROTHENE (ppb)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.50 *	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
1,1-DICHLOROPROPENE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	
1,2-DIBROMOETHANE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	
1,2-DICHLOROETHANE (ppb)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
1,2-DICHLOROPROPANE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	
2,2-DICHLOROPROPANE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	
2-CHLOROTOLUENE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	
4-CHLOROTOLUENE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	
BENZENE (ppb)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
BROMOBENZENE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	
BROMOCHLOROMETHANE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	
BROMODICHLOROMETHANE (ppb)	<1	<1	<1	<1	<1	<1.0 *	<1	1.9	<1.0 *	<1.0 *	<1	<1	
BROMOFORM (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	
BROMOMETHANE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	
CARBON TETRACHLORIDE (ppb)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
CHLOROBENZENE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	
CHLOROETHANE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	
CHLOROFORM (ppb)	2.9	4.4	3.6	<1	<1	7	<1	14	10	9.9	<1	<1	
CHLOROMETHANE (ppb)	<1.0 *	<1.0 *	<1	<1	<1	<1.0 *	<1	<1	<1	<1	<1	<1	
CIS-1,2-DICHLOROETHENE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	
CIS-1,3-DICHLOROPROPENE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	
CIS-1,3-DICHLOROPROPYLENE (ppb)	1	1.9	4.5	<1	<1	4.5	<1	<1.0 *	<1	<1	<1	<1	
DIBROMOCHLOROMETHANE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	
DIBROMOMETHANE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	
DICHLORODIFLUOROMETHANE (ppb)	4.3	2.3	2.4	<1	<1	6.6	<1	<1	<1	<1	<1	<1	
ETHYLBENZENE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	
XYLENE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	
M-P XYLENE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	
O-XYLENE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	
METHYLENE CHLORIDE (ppb)	<1.0 *	<1	<1	<1	<1	1.1	<1	<1	<1	<1	<1	<1	
STYRENE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	
TETRACHLOROETHENE (ppb)	2.7	2.3	3.4	<0.5	<0.5	8.1	<0.5	7.4	0.6	0.55	<0.5	<0.50	
TOLUENE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	
TRANS-1,2-DICHLOROETHENE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	

ALL quantities in mg/L unless otherwise noted
Blank line indicates parameter not tested.



Table 2.3 - SUMMARY OF HELENA LANDFILL AREA WATER QUALITY

Client: CHHL01 - City of Helena
Project: Hlra Landfill MtnrgPage: 2
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Sample Type: Other Sites

SITE CODE	13	13	13	19	20	23	26	28	31	31	31	32
SAMPLE DATE	02/16/90	05/04/90	04/04/91	05/04/90	05/06/90	05/06/90	05/03/90	06/05/90	05/03/90	05/03/90	04/13/91	05/03/90
LAB	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL
LAB NUMBER	90-3298	90-10822	91-12763	90-10823	90-10825	90-10826	90-10817	90-15038	90-10820	90-10820	91-13088	90-10818
REMARKS			Helena Landfi							DUPLICATE	Helena Landfi	
SAMPLE NUMBER	HYD-5710	HYD-5711	HL9104-100	HYD-5696	HYD-5779	HYD-5747	HYD-5742	HYD-5699	HYD-5750	HYD-5751	HL9104-111	HYD-5755
-- VOLATILE ORGANICS --												
TRANS-1,3-DICHLOROPROPENE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
TRICHLOROETHENE (ppb)	<0.50 *	0.74	0.5	<0.5	<0.5	1.8	<0.5	<0.50 *	<0.5	<0.5	<0.5	<0.5
TRICHLOROFUOROMETHANE (ppb)	<1	<1.0 *	<1	<1	<1	<1.0 *	<1	<1	<1	<1	<1	<1
VINYL CHLORIDE (ppb)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
-- SEMI-VOLATILE EXTRACTABLES --												
1,2,3-TRICHLOROBENZENE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,2,3-TRICHLOROPROPANE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,2,4-TRICHLOROBENZENE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,2,4-TRIMETHYLBENZENE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,2-DIBROMO-3-CHLOROPROPANE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,2-DICHLOROBENZENE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,3,5-TRIMETHYLBENZENE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,3-DICHLOROBENZENE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,3-DICHLOROPROPANE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,4-DICHLOROBENZENE (ppb)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
HEXACHLOROBUTADIENE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
ISOPROPYLBENZENE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
N-BUTYLBENZENE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
N-PROPYLBENZENE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
NAPHTHALENE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
P-ISOPROPYLTOLUENE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
SEC-BUTYLBENZENE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
TERT-BUTYLBENZENE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1

All quantities in mg/L unless otherwise noted
Blank line indicates parameter not tested.

Table 2.3 - SUMMARY OF HELENA LANDFILL AREA WATER QUALITY
Client: CHIL01 - City of Helena
Project: Helena Landfill Mtnng

Sample Type: Other Sites

SITE CODE	34	36	36	36	38	38	38	40	40	42	48	51	52
SAMPLE DATE	05/06/90	06/05/90	06/05/90	06/05/90	05/03/90	05/03/90	05/03/90	05/06/90	04/13/91	05/03/90	06/01/90	06/01/90	04/04/91
LAB	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL
LAB NUMBER	90-10824	90-15040	90-15040	90-15040	90-10833	90-10821	90-10821	90-10831	91-13086	90-10819	90-14925	90-14926	91-12765
REMARKS													
SAMPLE NUMBER	HYD-5736	HYD-5697	HYD-5698	HYD-5745	HYD-5746	HYD-5709	HYD-5778	HYD-5739	HL9104-109	HL9104-110	HL9104-102	HL9104-102	HL9104-102
-- VOLATILE ORGANICS --													
1,1,1,2-TETRACHLOROETHANE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	1	<1	<1	<1	0.6
1,1,1-TRICHLOROETHANE (ppb)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<1	<1	<1	<1
1,1,2,2-TETRACHLOROETHANE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,1,2-TRICHLOROETHANE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,1-DICHLOROETHANE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,1-DICHLOROETHANE (ppb)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1-DICHLOROPROPENE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,2-DIBROMOETHANE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,2-DICHLOROETHANE (ppb)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2-DICHLOROPROPANE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
2,2-DICHLOROPROPANE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
2-BUTANONE													
2-CHLOROETHYL VINYL ETHER													
2-CHLOROTOLUENE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
2-HEXANONE													
4-CHLOROTOLUENE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
4-METHYL-2-PENTANONE													
ACETONE													
ACROLEIN													
ACRYLONITRILE	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
BENZENE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
BROMOBENZENE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
BROMOCHLOROMETHANE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
BROMODICHLOROMETHANE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
BROMOFORM (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
BROMOMETHANE	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
BROMOMETHANE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
CARBON DISULFIDE	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CARBON TETRACHLORIDE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
CHLOROBENZENE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
CHLOROETHANE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
CHLOROFORM (ppb)	5.6	<1	<1	<1	7.9	9	11	11	<1	2.8	1.6	2.3	4.3
CHLOROMETHANE													
CHLOROMETHANE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
CIS-1,2-DICHLOROETHENE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
CIS-1,3-DICHLOROPROPENE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
CIS-1,3-DICHLOROPROPYLENE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
DIBROMOCHLOROMETHANE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
DIBROMOMETHANE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1

All quantities in mg/L unless otherwise noted
Blank line indicates parameter not tested.

Table 2.3 - SUMMARY OF HELENA LANDFILL AREA WATER QUALITY
Client: CHHLO1 - City of Helena
Project: Hlna Landfill Mtrng

Page: 4
07/16/91

Sample Type: Other Sites

SITE CODE		34	36	36	38	40	40	42	48	51	52
SAMPLE DATE		05/06/90	06/05/90	06/05/90	05/03/90	05/06/90	04/13/91	05/03/90	06/01/90	06/01/90	04/04/91
LAB		EL	EL	EL	EL	EL	EL	EL	EL	EL	EL
LAB NUMBER		90-10824	90-15040	90-15040	90-10821	90-10831	91-13086	90-10819	90-14925	90-14926	91-12765
REMARKS				DUPLICATE	HYD-5746	HYD-5709	Helena Landfi HL9104-109	HYD-5739	HYD-5778	Helena Landfi HL9104-110	Helena Landfi HL-9104-102
SAMPLE NUMBER		HYD-5736	HYD-5697	HYD-5698	HYD-5745	HYD-5709	HL9104-109	HYD-5739	HYD-5778	HYD-5702	HL-9104-102
-- VOLATILE ORGANICS --											
DICHLORODIFLUOROMETHANE (ppb)											
ETHYL METHACRYLATE											
ETHYLBENZENE (ppb)		<1	<1	<1	<1.0 *	4.5	2.1	4.6	1	1.8	3.2
TOLUENE		<1	<1	<1	<1	<1	<10	<1	<1	<1	<1
M-P XYLENE (ppb)		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
O-XYLENE (ppb)		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
METHYLENE CHLORIDE (ppb)		<1	<1	<1	<1	1	<1	<1.0 *	<1	<1	<1
STYRENE		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
TETRACHLOROETHENE (ppb)		2.2	<0.5	<0.5	0.97	8	5.6	5	1.7	1.7	2.2
TOLUENE (ppb)		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
TRANS-1,2-DICHLOROETHENE (ppb)		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
TRANS-1,3-DICHLOROPROPENE (ppb)		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
TRICHLOROETHENE (ppb)		<0.5	<0.5	<0.5	<0.5	1.3	0.88	0.5	<0.50 *	<0.50 *	<0.5
TRICHLOROFLUOROMETHANE		<1	<1	<1	<1	<1.0 *	<1	<1.0 *	<1.0 *	<1.0 *	<1
TRICHLOROFLUOROMETHANE (ppb)		<1	<1	<1	<1	<1.0 *	<1	<1.0 *	<1.0 *	<1.0 *	<1
VINYL ACETATE		<0.5	<0.5	<0.5	<0.5	<0.5	<10	<0.5	<0.5	<0.5	<0.5
VINYL CHLORIDE (ppb)		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
-- SEMI-VOLATILE EXTRACTABLES --											
1,2,3-TRICHLOROBENZENE (ppb)		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,2,3-TRICHLOROPROPANE (ppb)		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,2,4-TRICHLOROBENZENE (ppb)		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,2,4-TRIMETHYLBENZENE (ppb)		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,2-DIBROMO-3-CHLOROPROPANE (ppb)		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,2-DICHLOROBENZENE (ppb)		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,3,5-TRIMETHYLBENZENE (ppb)		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,3-DICHLOROBENZENE (ppb)		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,3-DICHLOROPROPANE (ppb)		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,4-DICHLOROBENZENE		<0.5	<0.5	<0.5	<0.5	<0.5	<10	<0.5	<0.5	<0.5	<0.5
1,4-DICHLOROBENZENE (ppb)		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
HEXACHLOROBUTADIENE (ppb)		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
ISOPROPYLBENZENE (ppb)		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
N-BUTYLBENZENE (ppb)		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
N-PROPYLBENZENE (ppb)		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
NAPHTHALENE (ppb)		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
P-ISOPROPYLTOLUENE (ppb)		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
SEC-BUTYLBENZENE (ppb)		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1

All quantities in mg/L unless otherwise noted
Blank line indicates parameter not tested.

Gift of Mrs. J. P. Morgan

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100

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Table 2.3 - SUMMARY OF HELENA LANDFILL AREA WATER QUALITY

Client: CHHL01 - City of Helena

Project: Hlna Landfill Mtrng

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Sample Type: Other Sites

SITE CODE	34	36	36	38	38	40	40	42	48	5	51	52
SAMPLE DATE	05/06/90	06/05/90	06/05/90	05/03/90	05/03/90	05/06/90	04/13/91	05/03/90	06/01/90	04/13/91	06/01/90	04/04/91
LAB	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL
LAB NUMBER	90-10824	90-15040	90-15040	90-10833	90-10821	90-10831	91-13086	90-10819	90-14925	91-13087	90-14926	91-12765
REMARKS				DUPLICATE			Helena Landfi			Helena Landfi		Helena Landfi
SAMPLE NUMBER	HYD-5736	HYD-5697	HYD-5698	HYD-5745	HYD-5746	HYD-5709	HL9104-109	HYD-5739	HYD-5778	HL9104-110	HYD-5702	HL-9104-102

-- SEMI-VOLATILE EXTRACTABLES --
TERT-BUTYLBENZENE (ppb)

<1

<1

<1

<1

<1

<1

<1

All quantities in mg/L unless otherwise noted
Blank line indicates parameter not tested.

Table 2.3 - SUMMARY OF HELENA LANDFILL AREA WATER QUALITY
 Client: CHHL01 - City of Helena
 Project: Hlna Landfill Mtrng

Sample Type: Other Sites

SITE CODE	59	59	67	67	68	82-1	82-2	82-2	82-2	82-2	82-2	82-2
SAMPLE DATE	06/01/90	04/04/91	06/01/90	06/01/90	04/04/91	12/01/82	12/01/82	04/07/86	09/10/86	06/15/87	10/20/88	05/25/89
LAB	EL	EL	EL	EL	EL	EL	EL					
LAB NUMBER	90-14927	91-12766	90-14928	90-14929	91-12764							
REMARKS	Helena Landfi	Helena Landfi	DEEP	SHALLOW	Helena Landfi							
SAMPLE NUMBER	HYD-5701	HL9104-103	HYD-5776	HYD-5777	HL9104-101	HYD-5716	HYD-5717	HYD-5718	HYD-5719	HYD-5720	HYD-5721	HYD-5722
						7.1	7.1	1200		1000	1100	1100
						822	1160					
						483	786					
						760	50					
						410	618	500	540	490	520	570
						90	162					
						45	52					
						23	24	29	20	24	28	38
						3	5					
						182	216	210	210	180	210	200
						221	263					
						0	0					
						194	335	36	35	35	37	40
						40	34					
						11.9	35	11	6.1	18.8	6	8.7
						0.001	0.001	0.003	0.005	0.007	0.03	<0.002
						<0.01	<0.01	0.04	0.01	<0.005	<0.01	<0.01
						0.88	0.14	0.19	0.17	0.02	0.03	0.03
						<0.01	<0.01		0.01	0.41	0.04	0.04
								0.01	0.01	0.01	0.22	<0.01
						0.24	0.03					
						<0.01	<0.01	0.006	0.01	0.03	0.05	<0.002
								0.05	0.02	0.56	0.07	<0.01
												0.02

-- PHYSICAL PARAMETERS --

PH
 SPEC. COND. (UMHOS/CM)
 TOTAL DISS. SOLIDS MEAS.
 TURBIDITY

-- COMMON IONS --

TOTAL HARDNESS AS CaCO3
 CALCIUM (CA)
 MAGNESIUM (MG)
 SODIUM (NA)
 SODIUM (NA) *TOT
 POTASSIUM (K)
 TOTAL ALKALINITY AS CaCO3
 ALKALINITY AS CaCO3
 BICARBONATE (HCO3)
 CARBONATE AS CO3
 SULFATE (SO4)
 CHLORIDE (CL)

-- NUTRIENTS --

NITRATE + NITRITE AS N

-- TRACE ELEMENTS --

CADMIUM (CD) *DIS
 CADMIUM (CD) *TOT
 CHROMIUM (CR) *TOT
 COPPER (CU) *DIS
 COPPER (CU) *TOT
 IRON (FE) *DIS
 LEAD (PB) *DIS
 LEAD (PB) *TOT
 MANGANESE (MN) *DIS
 MERCURY (HG) *TOT
 NICKEL (NI) *TOT
 ZINC (ZN) *DIS
 ZINC (ZN) *TOT

-- VOLATILE ORGANICS --

1,1,1,2-TETRACHLOROETHANE (ppb)

* DIS - Dissolved
 * TOT - Total
 All quantities in mg/L unless otherwise noted
 Blank line indicates parameter not tested.

Table 2.3 - SUMMARY OF HELENA LANDFILL AREA WATER QUALITY
Client: CHIL01 - City of Helena
Project: Hlna Landfill Mtrng

Sample Type: Other Sites

SITE CODE	59	59	67	67	68	82-1	82-2	82-2	82-2	82-2	82-2
LAB	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL
DATE	06/01/90	04/04/91	06/01/90	06/01/90	06/01/90	12/01/82	04/07/86	09/10/86	06/15/87	10/20/88	05/25/89
LAB NUMBER	90-14927	91-12766	90-14928	90-14928	90-14929	91-12764					
REMARKS	Helena Landfi	Helena Landfi	DEEP	DEEP	SHALLOW	Helena Landfi					
SAMPLE NUMBER	HYD-5701	HL9104-103	HYD-5776	HYD-5776	HYD-5777	HL9104-101	HYD-5716	HYD-5717	HYD-5720	HYD-5721	HYD-5722
-- VOLATILE ORGANICS --											
1,1,1-TRICHLOROETHANE (ppb)	<0.50 *	<0.5	<0.5	<0.5	<0.5	<0.5					
1,1,2,2-TETRACHLOROETHANE (ppb)	<1	<1	<1	<1	<1	<1					
1,1,2-TRICHLOROETHANE (ppb)	<1	<1	<1	<1	<1	<1					
1,1-DICHLOROETHANE (ppb)	<1.0 *	<1	<1	<1	<1	<1					
1,1-DICHLOROETHENE (ppb)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5					
1,1-DICHLOROPROPENE (ppb)	<1	<1	<1	<1	<1	<1					
1,2-DIBROMOETHANE (ppb)	<1	<1	<1	<1	<1	<1					
1,2-DICHLOROETHANE (ppb)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5					
1,2-DICHLOROPROPANE (ppb)	<1	<1	<1	<1	<1	<1					
2,2-DICHLOROPROPANE (ppb)	<1	<1	<1	<1	<1	<1					
2-CHLOROTOLUENE (ppb)	<1	<1	<1	<1	<1	<1					
4-CHLOROTOLUENE (ppb)	<1	<1	<1	<1	<1	<1					
BENZENE (ppb)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5					
BROMOBENZENE (ppb)	<1	<1	<1	<1	<1	<1					
BROMOCHLOROMETHANE (ppb)	<1	<1	<1	<1	<1	<1					
BROMODICHLOROMETHANE (ppb)	<1	<1	<1	<1	<1	<1					
BROMOFORM (ppb)	<1	<1	<1	<1	<1	<1					
BROMOMETHANE (ppb)	<1	<1	<1	<1	<1	<1					
CARBON TETRACHLORIDE (ppb)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5					
CHLOROBENZENE (ppb)	<1	<1	<1	<1	<1	<1					
CHLOROETHANE (ppb)	<1	<1	<1	<1	<1	<1					
CHLOROFORM (ppb)	1.6	1.8	<1	<1	1.1	<1					
CHLOROMETHANE (ppb)	<1	<1	<1	<1	<1	<1					
CIS-1,2-DICHLOROETHENE (ppb)	<1	<1	<1	<1	<1	<1					
CIS-1,3-DICHLOROPROPENE (ppb)	<1	<1	<1	<1	<1	<1					
CIS-1,3-DICHLOROPROPYLENE (ppb)	<1.0 *	<1	<1	<1	<1	<1					
DIBROMOCHLOROMETHANE (ppb)	<1	<1	<1	<1	<1	<1					
DIBROMOMETHANE (ppb)	<1	<1	<1	<1	<1	<1					
DICHLORODIFLUOROMETHANE (ppb)	1.3	2.4	<1	<1	<1.0 *	<1					
ETHYLBENZENE (ppb)	<1	<1	<1	<1	<1	<1					
XYLENE (ppb)	<1	<1	<1	<1	<1	<1					
M-P XYLENE (ppb)	<1	<1	<1	<1	<1	<1					
O-XYLENE (ppb)	<1	<1	<1	<1	<1	<1					
METHYLENE CHLORIDE (ppb)	<1	<1	<1	<1	<1	<1					
STYRENE (ppb)	<1	<1	<1	<1	<1	<1					
TETRACHLOROETHENE (ppb)	1.1	1.3	<1	<0.5	0.64	<0.5					
TOLUENE (ppb)	<1	<1	<1	<1	<1	<1					

* DIS - Dissolved

* TOT - Total

All quantities in mg/L unless otherwise noted
Blank line indicates parameter not tested.

Table 2.3 - SUMMARY OF HELENA LANDFILL AREA WATER QUALITY
Client: CHL01 - City of Helena
Project: Helena Landfill Mtnng

Sample Type: Other Sites

SITE CODE	59	59	67	67	67	68	82-1	82-2	82-2	82-2	82-2	82-2
SAMPLE DATE	06/01/90	04/04/91	06/01/90	06/01/90	06/01/90	04/04/91	12/01/82	12/01/82	04/07/86	09/10/86	06/15/87	10/20/88
LAB	EL	EL	EL	EL	EL	EL	EL	EL				
LAB NUMBER	90-14927	91-12766	90-14928	90-14928	90-14929	91-12764						
REMARKS	Helena Landfi	HL9104-103	DEEP	DEEP	SHALLOW	Helena Landfi						
SAMPLE NUMBER	HYD-5701	HL9104-103	HYD-5776	HYD-5776	HYD-5777	HL9104-101	HYD-5716	HYD-5717	HYD-5718	HYD-5719	HYD-5720	HYD-5721
-- VOLATILE ORGANICS --												
TRANS-1,2-DICHLOROETHENE (ppb)	<1	<1	<1	<1	<1	<1						
TRANS-1,3-DICHLOROPROPENE (ppb)	<1	<1	<1	<1	<1	<1						
TRICHLOROETHENE (ppb)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5						
TRICHLOROFLUOROMETHANE (ppb)	<1.0 *	<1	<1	<1	<1	<1						
VINYL CHLORIDE (ppb)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5						
-- SEMI-VOLATILE EXTRACTABLES --												
1,2,3-TRICHLOROBENZENE (ppb)	<1	<1	<1	<1	<1	<1						
1,2,3-TRICHLOROPROPANE (ppb)	<1	<1	<1	<1	<1	<1						
1,2,4-TRICHLOROBENZENE (ppb)	<1	<1	<1	<1	<1	<1						
1,2,4-TRIMETHYLBENZENE (ppb)	<1	<1	<1	<1	<1	<1						
1,2-DIBROMO-3-CHLOROPROPANE (ppb)	<1	<1	<1	<1	<1	<1						
1,2-DICHLOROBENZENE (ppb)	<1	<1	<1	<1	<1	<1						
1,3,5-TRIMETHYLBENZENE (ppb)	<1	<1	<1	<1	<1	<1						
1,3-DICHLOROBENZENE (ppb)	<1	<1	<1	<1	<1	<1						
1,3-DICHLOROPROPANE (ppb)	<1	<1	<1	<1	<1	<1						
1,4-DICHLOROBENZENE (ppb)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5						
HEXACHLOROBUTADIENE (ppb)	<1	<1	<1	<1	<1	<1						
ISOPROPYLBENZENE (ppb)	<1	<1	<1	<1	<1	<1						
N-BUTYLBENZENE (ppb)	<1	<1	<1	<1	<1	<1						
N-NITROSO-DI-N-BUTYLAMINE (ppb)	<1	<1	<1	<1	<1	<1						
N-PROPYLBENZENE (ppb)	<1	<1	<1	<1	<1	<1						
NAPHTHALENE (ppb)	<1	<1	<1	<1	<1	<1						
P-ISOPROPYLTOLUENE (ppb)	<1	<1	<1	<1	<1	<1						
SEC-BUTYLBENZENE (ppb)	<1	<1	<1	<1	<1	<1						
TERT-BUTYLBENZENE (ppb)	<1	<1	<1	<1	<1	<1						

* DIS - Dissolved

* TOT - Total

All quantities in mg/L unless otherwise noted
Blank line indicates parameter not tested.

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SITE CODE	82-3	82-3	82-3	82-3	82-3	82-3	82-3	82-4	82-4	82-4	82-4	82-4
SAMPLE DATE	12/01/82	12/01/82	EL	04/07/86	09/10/86	06/15/87	10/20/88	05/25/89	12/01/82	04/07/86	09/10/86	06/15/87
LAB NUMBER	EL	EL							EL			EL
REMARKS												
SAMPLE NUMBER	HYD-5729	HYD-5730	DUPPLICATE	HYD-5731	HYD-5732	HYD-5733	HYD-5734	HYD-5735	HYD-5763	HYD-5764	HYD-5765	HYD-5766
-- PHYSICAL PARAMETERS --												
P H	6.8	6.8		1300		1130	1200	1140	7.5	820		890
SPEC. COND. (UMHOS/CM)	1320	1320							778			
TOTAL DISS. SOLIDS MEAS.	840	848							460			
TURBIDITY	86	88							44			
-- COMMON IONS --												
TOTAL HARDNESS AS CaCO3	682	696		550	620	570	530	610	379	340	380	430
CALCIUM (CA)	175	180							103			
MAGNESIUM (MG)	60	60							30			
SODIUM (NA)	49	49							27			
SODIUM (NA) *TOT				43	42	40	46	40		31	26	28
POTASSIUM (K)	6	6							3			
TOTAL ALKALINITY AS CaCO3	496	500		440	430	370	440	400	222	240	230	260
ALKALINITY AS CaCO3									271			
BICARBONATE (HCO3)	605	610							0			
CARBONATE AS O3	0	0							132			
SULFATE (SO4)	190	186		38	38	36	35	41	37	32	31	33
CHLORIDE (CL)	44	43										
-- NUTRIENTS --												
NITRATE + NITRITE AS N	8.9	9.1		5.6	1.9	6	5.1	5	8.3	5.2	5	6.3
-- TRACE ELEMENTS --												
CADMIUM (CD) *DIS	<0.001	0.001		<0.002	<0.002	<0.002	<0.005	<0.002	0.002	<0.002	0.003	<0.002
CADMIUM (CD) *TOT												0.02
CHROMIUM (CR) *TOT												
COPPER (CU) *DIS	<0.01	<0.01							<0.01			
COPPER (CU) *TOT												
IRON (FE) *DIS	<0.03	<0.03		0.02	0.06	0.01	0.02	0.07	<0.01	0.04	0.11	0.03
LEAD (PB) *DIS	0.01	<0.01		<0.03	<0.03	<0.03	<0.03	<0.03	<0.01	<0.03	<0.03	0.19
LEAD (PB) *TOT				0.007	0.01	0.006	0.07	<0.01	<0.01	0.05	0.04	0.01
MANGANESE (MN) *DIS	<0.02	<0.02							<0.02			
MERCURY (HG) *TOT												
NICKEL (NI) *TOT				<0.005	0.01	0.007	<0.01	0.002		0.005	0.02	0.01
ZINC (ZN) *DIS	0.01	0.02		0.02	0.01	0.01	<0.01	<0.01	<0.01			
ZINC (ZN) *TOT					0.01	0.01	0.04	0.06		0.04	0.14	0.04

-- VOLATILE ORGANICS --
1,1,1,2-TETRACHLOROETHANE (ppb)

* DIS - Dissolved

* TOT - Total

All quantities in mg/L unless otherwise noted.
Blank line indicates parameter not tested.

Table 2.3 - SUMMARY OF HELENA LANDFILL AREA WATER QUALITY
Client: CHHL01 - City of Helena
Project: Helena Landfill Mtnng

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Sample Type: Other Sites

SITE CODE	82-3	82-3	82-3	82-3	82-3	82-3	82-3	82-4	82-4	82-4	82-4	82-4
SAMPLE DATE	12/01/82	12/01/82	04/07/86	09/10/86	06/15/87	10/20/88	05/25/89	12/01/82	04/07/86	09/10/86	06/15/87	11/11/89
LAB	EL	EL						EL				EL
LAB NUMBER	HYD-5729	HYD-5730	HYD-5731	HYD-5732	HYD-5733	HYD-5734	HYD-5735	HYD-5763	HYD-5764	HYD-5765	HYD-5766	HYD-5767
REMARKS	DUPLICATE											
SAMPLE NUMBER	82-3	82-3	82-3	82-3	82-3	82-3	82-3	82-3	82-4	82-4	82-4	82-4
-- VOLATILE ORGANICS --												
1,1,1-TRICHLOROETHANE (ppb)												9.8
1,1,2,2-TETRACHLOROETHANE (ppb)												<1
1,1,2-TRICHLOROETHANE (ppb)												<1
1,1-DICHLOROETHANE (ppb)												2.4
1,1-DICHLOROETHENE (ppb)												<0.50 *
1,1-DICHLOROPROPENE (ppb)												<1
1,2-DIBROMOETHANE (ppb)												<1
1,2-DICHLOROETHANE (ppb)												<0.5
1,2-DICHLOROPROPANE (ppb)												<1
2,2-DICHLOROPROPANE (ppb)												<1
2-CHLOROTOLUENE (ppb)												<1
4-CHLOROTOLUENE (ppb)												<0.5
BENZENE (ppb)												<1
BROMOBENZENE (ppb)												<1
BROMOCHLOROMETHANE (ppb)												<1
BROMODICHLOROMETHANE (ppb)												<1
BROMOFORM (ppb)												<1
BROMOMETHANE (ppb)												<1
CARBON TETRACHLORIDE (ppb)												<0.5
CHLOROBENZENE (ppb)												<1
CHLOROETHANE (ppb)												<1
CHLOROFORM (ppb)												<1.0 *
CIS-1,2-DICHLOROETHENE (ppb)												<1.0 *
CIS-1,3-DICHLOROPROPENE (ppb)												33
CIS-1,3-DICHLOROPROPYLENE (ppb)												<1
DIBROMOCHLOROMETHANE (ppb)												<1
DIBROMOMETHANE (ppb)												67
DICHLORODIFLUOROMETHANE (ppb)												<1
ETHYLBENZENE (ppb)												<1
XYLENE (ppb)												<1
M-P XYLENE (ppb)												<1
O-XYLENE (ppb)												<1
METHYLENE CHLORIDE (ppb)												7.5
STYRENE (ppb)												<1
TETRACHLOROETHENE (ppb)												4.8
TOLUENE (ppb)												<1
TRANS-1,2-DICHLOROETHENE (ppb)												<1

-- VOLATILE ORGANICS --

1,1,1-TRICHLOROETHANE (ppb)	9.8
1,1,2,2-TETRACHLOROETHANE (ppb)	<1
1,1,2-TRICHLOROETHANE (ppb)	<1
1,1-DICHLOROETHANE (ppb)	2.4
1,1-DICHLOROETHENE (ppb)	<0.50 *
1,1-DICHLOROPROPENE (ppb)	<1
1,2-DIBROMOETHANE (ppb)	<1
1,2-DICHLOROETHANE (ppb)	<0.5
1,2-DICHLOROPROPANE (ppb)	<1
2,2-DICHLOROPROPANE (ppb)	<1
2-CHLOROTOLUENE (ppb)	<1
4-CHLOROTOLUENE (ppb)	<1
BENZENE (ppb)	<0.5
BROMOBENZENE (ppb)	<1
BROMOCHLOROMETHANE (ppb)	<1
BROMODICHLOROMETHANE (ppb)	<1
BROMOFORM (ppb)	<1
BROMOMETHANE (ppb)	<1
CARBON TETRACHLORIDE (ppb)	<0.5
CHLOROBENZENE (ppb)	<1
CHLOROETHANE (ppb)	<1
CHLOROFORM (ppb)	<1
CIS-1,2-DICHLOROETHENE (ppb)	<1.0 *
CIS-1,3-DICHLOROPROPENE (ppb)	<1.0 *
CIS-1,3-DICHLOROPROPYLENE (ppb)	<1
DIBROMOCHLOROMETHANE (ppb)	33
DIBROMOMETHANE (ppb)	<1
DICHLORODIFLUOROMETHANE (ppb)	<1
ETHYLBENZENE (ppb)	67
XYLENE (ppb)	<1
M-P XYLENE (ppb)	<1
O-XYLENE (ppb)	<1
METHYLENE CHLORIDE (ppb)	<1
STYRENE (ppb)	7.5
TETRACHLOROETHENE (ppb)	<1
TOLUENE (ppb)	4.8
TRANS-1,2-DICHLOROETHENE (ppb)	<1

* DIS - Dissolved

* TOT - Total

All quantities in mg/L unless otherwise noted

Blank line indicates parameter not tested.

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 of the following public sector enterprises
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Table 2.3 - SUMMARY OF HELENA LANDFILL AREA WATER QUALITY
Client: CHH01 - City of Helena
Project: Helena Landfill Mtnrg

Page: 11
07/16/91

Sample Type: Other Sites

REMARKS	SAMPLE NUMBER	LAB NUMBER	SITE CODE	SAMPLE DATE	LAB	EL	82-3	04/07/86	82-3	09/10/86	82-3	06/15/87	82-3	10/20/88	82-3	05/25/89	82-4	12/01/82	EL	82-4	04/07/86	82-4	09/10/86	82-4	06/15/87	82-4	11/11/89	EL	82-4	89-20180	HYD-5767
TRANS-1,3-DICHLOROPROPENE (ppb)																															
TRICHLOROETHENE (ppb)																															
TRICHLOROFLUOROMETHANE (ppb)																															
VINYL CHLORIDE (ppb)																															
1,2-DIBROMO-3-CHLOROPROPANE (ppb)																															
1,2-DICHLOROBENZENE (ppb)																															
1,3,5-TRIMETHYLBENZENE (ppb)																															
1,3-DICHLOROBENZENE (ppb)																															
1,3-DICHLOROPROPANE (ppb)																															
1,4-DICHLOROBENZENE (ppb)																															
HEXACHLOROCYCLOPENTADIENE (ppb)																															
ISOPROPYLBENZENE (ppb)																															
N-BUTYLBENZENE (ppb)																															
N-NITROSO-DI-N-BUTYLAMINE (ppb)																															
N-PROPYLBENZENE (ppb)																															
NAPHTHALENE (ppb)																															
P-ISOPROPYLTOLUENE (ppb)																															
SEC-BUTYLBENZENE (ppb)																															
TERT-BUTYLBENZENE (ppb)																															

* DIS - Dissolved

* TOT - Total

All quantities in mg/L unless otherwise noted
Blank line indicates parameter not tested.

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Table 2.3 - SUMMARY OF HELENA LANDFILL AREA WATER QUALITY

Client: CHHL01 - City of Helena
Project: Helena Landfill Mtnng

Page: 12
07/16/91

Sample Type: Other Sites

SITE CODE	82-4	83-5	83-5	83-5	83-5	83-6	83-6	83-6	83-6	83-6	83-6	83-7
SAMPLE DATE	05/11/90	04/07/86	09/10/86	10/20/88	05/25/89	04/07/86	09/10/86	06/15/87	10/20/88	05/25/89	04/05/91	04/07/86
LAB	EL										EL	
LAB NUMBER	90-12199										91-12769	
REMARKS											Helena Landfi	
SAMPLE NUMBER	HYD-5768	HYD-5723	HYD-5724	HYD-5725	HYD-5726	HYD-5704	HYD-5705	HYD-5706	HYD-5707	HYD-5708	HL9104-106	HYD-5712
PH (pH units)		1100		980	840	910		850	780	770	7.5	2300
SPEC. COND. (UMHOS/CM)											511	
TDS MEAS. @ 180 DEG. C												
-- COMMON IONS --												
TOTAL HARDNESS AS CaCO3		490	510	460	440	390	530	700	340	390	114	1100
CALCIUM (CA) *DIS											31	
MAGNESIUM (MG) *DIS											23	
SODIUM (NA) *DIS		28	20	26	23	24	17	20	23	22	5	83
SODIUM (NA) *TOT											255	
POTASSIUM (K) *DIS												
TOTAL ALKALINITY AS CaCO3		290	290	340	250	220	210	220	230	240	311	490
BICARBONATE (HCO3)											0	
CARBONATE AS CO3		39	32	45	25	34	44	30	41	39	109	190
SULFATE (SO4)											32	
CHLORIDE (CL)												
-- NUTRIENTS --												
NITRATE + NITRITE AS N		1.1	0.25	0.13	0.55	7.6	0.46	8	2.1	0.6	8.91	<0.1
NITROGEN AS N											<0.1	
-- TRACE ELEMENTS --												
ARSENIC (AS)												
ARSENIC (AS) *DIS		0.006	<0.002	0.04	<0.002	<0.002	<0.002	0.003	<0.005	<0.002	<0.005	0.008
BARIUM (BA) *DIS											<0.005	
CADMIUM (CD) *DIS											<0.1	
CADMIUM (CD) *TOT											<0.001	
CHROMIUM (CR) *DIS											<0.02	
CHROMIUM (CR) *TOT				<0.01	<0.01	0.06		0.04	<0.01	<0.01		
COPPER (CU) *TOT		0.07	0.03	0.02	0.02	<0.03	0.05	0.11	0.03	0.02	<0.03	0.17
IRON (FE) *DIS		<0.03	<0.03	0.04	<0.03	<0.03	<0.03	0.03	<0.03	<0.03	<0.01	3.5
LEAD (PB) *DIS												
LEAD (PB) *TOT		0.01	0.01	0.01	<0.01	0.01	0.03	0.07	0.03	<0.01		0.05
MANGANESE (MN) *DIS											0.04	
MERCURY (HG) *DIS											<0.001	
MERCURY (HG) *TOT					<0.002					<0.002		

* DIS - Dissolved

* TOT - Total

All quantities in mg/L unless otherwise noted
Blank line indicates parameter not tested.

Table 2.3 - SUMMARY OF HELENA LANDFILL AREA WATER QUALITY

Client: CHHL01 - City of Helena
Project: Helena Landfill Mtrng

Page: 13
07/16/91

Sample Type: Other Sites

SITE CODE	82-4	83-5	83-5	83-5	83-6	83-6	83-6	83-6	83-6	83-6	83-7
SAMPLE DATE	05/11/90	04/07/86	09/10/86	10/20/88	05/25/89	04/07/86	09/10/86	06/15/87	10/20/88	05/25/89	04/05/91
LAB	EL										EL
LAB NUMBER	90-12199										91-12769
REMARKS											Helena Landfi
SAMPLE NUMBER	HYD-5768	HYD-5723	HYD-5724	HYD-5725	HYD-5726	HYD-5704	HYD-5705	HYD-5706	HYD-5707	HYD-5708	HYD-5712
-- TRACE ELEMENTS --											
NICKEL (NI) *TOT		0.008	0.01	0.09	<0.01	0.008	0.04	0.07	0.08	<0.01	<0.005
SELENIUM (SE) *DIS											<0.005
SILVER (AG) *DIS											
ZINC (ZN) *TOT		0.06	0.07	0.083	0.02	0.05	0.08	0.13	<0.005	0.03	0.26
-- VOLATILE ORGANICS --											
1,1,1-TRICHLOROETHANE (ppb)											2.9
1,1,2,2-TETRACHLOROETHANE (ppb)											<1
1,1,2-TRICHLOROETHANE (ppb)											<1
1,1-DICHLOROETHANE (ppb)											<0.5
1,1-DICHLOROETHENE (ppb)											<0.5
1,2-DICHLOROETHANE (ppb)											<0.5
BENZENE (ppb)											<1
BROMOCHLOROMETHANE (ppb)											<1
BROMODICHLOROMETHANE (ppb)											<1
BROMOFORM (ppb)											<1
BROMOMETHANE (ppb)											<0.5
CARBON TETRACHLORIDE (ppb)											<1
CHLOROBENZENE (ppb)											<1
CHLOROETHANE (ppb)											<1
CHLOROFORM (ppb)											3.2
CHLOROMETHANE (ppb)											<1
CIS-1,3-DICHLOROPROPENE (ppb)											<1
DIBROMOCHLOROMETHANE (ppb)											<1
DIBROMOMETHANE (ppb)											<1
DICHLORODIFLUOROMETHANE (ppb)											<1
ETHYLBENZENE (ppb)											<1
XYLENE (ppb)											<1
METHYLENE CHLORIDE (ppb)											<0.5
TETRACHLOROETHENE (ppb)											<1
TOLUENE (ppb)											<1
TRANS-1,2-DICHLOROETHENE (ppb)											<1
TRANS-1,3-DICHLOROPROPENE (ppb)											<1
TRICHLOROETHENE (ppb)											<0.5
TRICHLOROFLUOROMETHANE (ppb)											<1
VINYL CHLORIDE (ppb)											<0.5
-- SEMI-VOLATILE EXTRACTABLES --											
1,2,3-TRICHLOROPROPANE (ppb)											<1

* DIS - Dissolved

* TOT - Total

All quantities in mg/L unless otherwise noted
Blank line indicates parameter not tested.

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Sample Type: Other Sites

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All quantities in mg/L unless otherwise noted.
Blank line indicates parameter not tested.

Table 2.3 - SUMMARY OF HELENA LANDFILL AREA WATER QUALITY

Client: CHHL01 - City of Helena
Project: Helena Landfill Mtrng

Page: 15
07/16/91

Sample Type: Other Sites

SITE CODE	82-4	83-5	83-5	83-5	83-6	83-6	83-6	83-6	83-6	83-7
SAMPLE DATE	05/11/90	04/07/86	04/07/86	05/25/89	04/07/86	09/10/86	06/15/87	10/20/88	05/25/89	04/05/91
LAB	EL									EL
LAB NUMBER	90-12199									91-12769
REMARKS										Helena Landfi
SAMPLE NUMBER	HYD-5768	HYD-5723	HYD-5724	HYD-5725	HYD-5726	HYD-5704	HYD-5706	HYD-5707	HYD-5708	HL9104-106
-- SEMI-VOLATILE EXTRACTABLES --										
DIBENZO (A,H) ANTHRACENE (ppb)	<10									
DIETHYLPHTHALATE (ppb)	<10									
DIMETHYLPHTHALATE (ppb)	<10									
FLUORANTHENE (ppb)	<10									
FLUORENE (ppb)	<10									
HEXACHLOROBENZENE (ppb)	<10									
HEXACHLOROBUTADIENE (ppb)	<10									
HEXACHLOROETHANE (ppb)	<10									
INDENO (1,2,3-CD) PYRENE (ppb)	<10									
ISOPHORONE (ppb)	<10									
N-NITROSO-DI-N-PROPYLAMINE (ppb)	<10									
N-NITROSO-DEHYDROAMINE (ppb)	<10									
NAPHTHALENE (ppb)	<10									
NITROBENZENE (ppb)	<10									
PENTACHLOROPHENOL (ppb)	<50									
PHENANTHRENE (ppb)	<10									
PHENOL (ppb)	<10									
PYRENE (ppb)	<10									

-- HYDROCARBONS --

ORGANIC CARBON (TOTAL)

-- OTHER PARAMETERS --

CYANIDE (CN)

CHEMICAL OXYGEN DEMAND

* DIS - Dissolved

* TOT - Total

All quantities in mg/L unless otherwise noted
Blank line indicates parameter not tested.

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Table 2.3 - SUMMARY OF HELENA LANDFILL AREA WATER QUALITY

Client: CHHL01 - City of Helena

Project: Hlma Landfill Mtrng

Sample Type: Other Sites

SITE CODE	83-7	83-7	83-7	84	9	BLANK	BLANK	EPA-1	HL-1	HL-1	HL-1	HL-1
SAMPLE DATE	09/10/86	06/15/87	10/20/88	06/06/90	06/06/90	05/07/90	11/11/90	04/05/91	09/09/80	09/10/80	06/30/82	04/07/86
LAB				EL	EL	EL	EL	EL				
LAB NUMBER				90-15044	90-15042	90-10832	89-20184	91-12768				
REMARKS								Helena Landfi				
SAMPLE NUMBER	HYD-5713	HYD-5714	HYD-5715	HYD-5703	HYD-5700	HYD-5769	HYD-5770	HL9104-105	HYD-5797	HYD-5798	HYD-5799	HYD-5800
-- PHYSICAL PARAMETERS --												
PH												
PH (pH units)												
SPEC. COND. (UMHOS/CM)		2040	4500						6	7	7.7	
TDS MEAS. @ 180 DEG. C									840	900	1360	
TOTAL DISS. SOLIDS MEAS.									623	738	1700	
TURBIDITY												
-- COMMON IONS --												
TOTAL HARDNESS AS CaCO3	1200	1000	2600									950
CALCIUM (CA)												
CALCIUM (CA) *DIS												
MAGNESIUM (MG)												
MAGNESIUM (MG) *DIS												
SODIUM (NA)												
SODIUM (NA) *DIS												
SODIUM (NA) *TOT	65	57	210						32	27	71	64
POTASSIUM (K)												
POTASSIUM (K) *DIS												
TOTAL ALKALINITY AS CaCO3	480	450	810						229	272		
ALKALINITY AS CaCO3												
BICARBONATE (HCO3)											201	
CARBONATE AS CO3											0	
SULFATE (SO4)	190	190	180						218	227	270	
CHLORIDE (CL)											40	
-- NUTRIENTS --												
NITRATE (NO3-N)	0.13	0.05	<0.01						4.45	4.74	18	7.6
NITRATE + NITRITE AS N												
NITROGEN AS N												
-- TRACE ELEMENTS --												
ARSENIC (AS) *DIS								<0.005				
BARIUM (BA) *DIS								<0.1				
CADMIUM (CD) *DIS								<0.001	0.0029	0.005		0.014
CADMIUM (CD) *TOT	0.003	0.02	0.1						0.017	0.014		
CHROMIUM (CR) *DIS												
CHROMIUM (CR) *TOT		0.04	<0.01									

* DIS - Dissolved

* TOT - Total

All quantities in mg/L unless otherwise noted

Blank line indicates parameter not tested.

Table 2.3 - SUMMARY OF HELENA LANDFILL AREA WATER QUALITY

Client: CHHL01 - City of Helena
Project: Helena Landfill Mtnrg

Sample Type: Other Sites

[illegible]

* DIS - Dissolved

* TOT - Total

ALL quantities in mg/L unless otherwise noted.
Blank line indicates parameter not tested.

Before referring to any ship or station (1)

Refer to the following

See also 100

See also 100

See also 100

See also 100

See also 100

See also 100

See also 100

See also 100

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Table 2.3 - SUMMARY OF HELENA LANDFILL AREA WATER QUALITY
Client: CHHL01 - City of Helena
Project: Helena Landfill Mtrng

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07/16/91

Sample Type: Other Sites

SITE CODE	83-7	83-7	83-7	84	9	BLANK	BLANK	EPA-1	HL-1	HL-1	HL-1	HL-1
SAMPLE DATE	09/10/86	06/15/87	10/20/88	06/06/90	06/06/90	05/07/90	11/11/90	04/05/91	09/09/80	09/10/80	06/30/82	HL-1
LAB				EL	EL	EL	EL	EL				
LAB NUMBER				90-15044	90-15042	90-10832	89-20184	91-12768				
REMARKS								Helena Landfill				
SAMPLE NUMBER	HYD-5713	HYD-5714	HYD-5715	HYD-5703	HYD-5700	HYD-5769	HYD-5770	HL9104-105	HYD-5797	HYD-5798	HYD-5799	HYD-5800
--- VOLATILE ORGANICS ---												
CIS-1,3-DICHLOROPROPYLENE (ppb)				<1	<1	<1	<1	<1				
DIBROMOCHLOROMETHANE (ppb)				<1	<1	<1	<1	<1				
DIBROMOMETHANE (ppb)				<1	<1	<1	<1	<1				
DICHLORODIFLUOROMETHANE (ppb)				<1	<1	<1	<1	<1				
ETHYLBENZENE (ppb)				<1	<1	<1	<1	<1				
XYLENE (ppb)				<1	<1	<1	<1	<1				
M-P XYLENE (ppb)				<1	<1	<1	<1	<1				
O-XYLENE (ppb)				<1	<1	<1	<1	<1				
METHYLENE CHLORIDE (ppb)				<1	<1	<1	<1	4.2				
STYRENE (ppb)				<1	<1	<1	<1	66				
TETRACHLOROETHENE (ppb)				<0.5	<0.5	<0.5	<0.5	<1				
TOLENE (ppb)				<1	<1	<1	<1	<1				
TRANS-1,2-DICHLOROETHENE (ppb)				<1	<1	<1	<1	<1				
TRANS-1,3-DICHLOROPROPENE (ppb)				<1	<1	<1	<1	<1				
TRICHLOROETHENE (ppb)				<0.5	<0.5	<0.5	<0.5	7.4				
TRICHLOROFLUOROMETHANE (ppb)				<1	<1	<1	<1	4.3				
VINYL CHLORIDE (ppb)				<0.5	<0.5	<0.5	<0.5	<0.5				
SEMI-VOLATILE EXTRACTABLES --												
1,2,3-TRICHLOROBENZENE (ppb)				<1	<1	<1	<1	<1				
1,2,3-TRICHLOROPROPANE (ppb)				<1	<1	<1	<1	<1				
1,2,4-TRICHLOROBENZENE (ppb)				<1	<1	<1	<1	<1				
1,2,4-TRIMETHYLBENZENE (ppb)				<1	<1	<1	<1	<1				
1,2-DIBROMO-3-CHLOROPROPANE (ppb)				<1	<1	<1	<1	<1				
1,2-DICHLOROBENZENE (ppb)				<1	<1	<1	<1	<1				
1,3,5-TRIMETHYLBENZENE (ppb)				<1	<1	<1	<1	<1				
1,3-DICHLOROBENZENE (ppb)				<1	<1	<1	<1	<1				
1,3-DICHLOROPROPANE (ppb)				<1	<1	<1	<1	<1				
1,4-DICHLOROBENZENE (ppb)				<0.5	<0.5	<0.5	<0.5	<0.5				
HEXACHLOROBUTADIENE (ppb)				<1	<1	<1	<1	<1				
ISOPROPYLBENZENE (ppb)				<1	<1	<1	<1	<1				
N-BUTYLBENZENE (ppb)				<1	<1	<1	<1	<1				
N-NITROSO-DI-N-BUTYLAMINE (ppb)				<1	<1	<1	<1	<1				
N-PROPYLBENZENE (ppb)				<1	<1	<1	<1	<1				
NAPHTHALENE (ppb)				<1	<1	<1	<1	<1				
P-ISOPROPYLTOLUENE (ppb)				<1	<1	<1	<1	<1				
SEC-BUTYLBENZENE (ppb)				<1	<1	<1	<1	<1				
									163	456	89	

* DIS - Dissolved
* TOT - Total
All quantities in mg/L unless otherwise noted
Blank line indicates parameter not tested.

Sample Type: Other Sites

[illegible]

--- SEMI-VOLATILE EXTRACTABLES ---
TERT-BUTYLBENZENE (ppb)

-- HYDROCARBONS --
ORGANIC CARBON (TOTAL)

-- OTHER PARAMETERS --
CYANIDE (CN) *TOT
CHEMICAL OXGEN DEMAND

* DIS - Dissolved
* TOT - Total

* TOT - Total
All quantities in mg/L unless otherwise noted
Blank line indicates parameter not tested.

1. The following information was obtained from the records of the company for the year ended 31st December 2017:

1. Sales

2. Cost of Sales

3. Selling Expenses

4. Administrative Expenses

5. Depreciation

6. Dividend

7. Retained Profit

8. Share Capital

9. Reserve

10. Dividend

11. Retained Profit

12. Share Capital

13. Reserve

14. Dividend

15. Retained Profit

16. Dividend

17. Retained Profit

18. Share Capital

19. Reserve

20. Dividend

21. Retained Profit

22. Share Capital

23. Reserve

24. Dividend

25. Retained Profit

26. Share Capital

27. Reserve

28. Dividend

29. Retained Profit

30. Share Capital

31. Reserve

32. Dividend

33. Retained Profit

34. Share Capital

35. Reserve

36. Dividend

37. Retained Profit

38. Share Capital

39. Reserve

40. Dividend

41. Retained Profit

42. Share Capital

43. Reserve

44. Dividend

45. Retained Profit

46. Share Capital

47. Reserve

Table 2.3 - SUMMARY OF HELENA LANDFILL AREA WATER QUALITY
Client: CHIL01 - City of Helena
Project: Htra Landfill Mtrng

Sample Type: Other Sites

SITE CODE	HL-1	HL-1	HL-4	HL-4	HL-5	HL-5	HL-5	HL-5	HL-6	HL-6	HL-6	HL-6
SAMPLE DATE	10/20/88	05/25/89	09/09/80	06/30/82	09/09/80	06/30/82	06/30/82	04/07/86	09/09/80	09/10/80	06/30/82	04/07/86
LAB NUMBER	HYD-5801	HYD-5802	HYD-5781	HYD-5782	HYD-5783	HYD-5784	HYD-5785	HYD-5786	HYD-5793	HYD-5794	HYD-5795	HYD-5796
PH			6	7.1	6	7.2			6	7	7.5	
SPEC. COND. (UMHOS/CM)	1100	1000	1220	1650	1500	1280			1200	1070	1000	1300
TOTAL DISS. SOLIDS MEAS.			1035	34000	1293	5000			883	920	2700	
TURBIDITY												
-- COMMON IONS --												
TOTAL HARDNESS AS CaCO3	1000	490		179		171	158	960			147	660
CALCIUM (CA)				75		54	49				41	
MAGNESIUM (MG)				106	55	46	40		35	29	31	
SODIUM (NA)			40					54				
SODIUM (NA) *TOT	22	52	13	13	9	9	6		3	5.5	5	42
POTASSIUM (K)			282		529				294	285		410
ALKALINITY AS CaCO3	300	630		850		481					415	
BICARBONATE (HCO3)				0		0					0	
CARBONATE AS CO3				239	417	262			299	274	188	
SULFATE (SO4)			264	68		71					39	44
CHLORIDE (CL)	37	36										
-- NUTRIENTS --												
NITRATE (NO3-N)			12	7	0.28	1.44		0.83	12	7.15	9	4.6
NITRATE + NITRITE AS N	7.6	7.9					<0.05					
PHOSPHORUS (P) *TOT												
-- TRACE ELEMENTS --												
ALUMINUM (AL) *DIS							0.4					
ARSENIC (AS) *DIS							<0.05					
BARIUM (BA) *DIS							0.09					
BERYLLIUM (BE) *DIS							<0.01					
BORON (B)							0.49					
CADMIUM (CD) *DIS			0.001		0.0023		<0.01		0.0017	0.0005		0.004
CADMIUM (CD) *TOT	0.03	0.01						0.015				
CHROMIUM (CR) *DIS			0.014		0.018		<0.01		0.017	0.012		
CHROMIUM (CR) *TOT	0.12	0.12										
COPPER (CU) *DIS			0.0037		0.011		<0.01		0.39	0.001		
COPPER (CU) *TOT	1	0.24						0.29				0.1
IRON (FE) *DIS	0.04	<0.03		7.66		1.92	1.92	0.06			16.8	<0.03
LEAD (PB) *DIS			0.043	<0.01	0.024	<0.01	<0.01		0.021	0.042	<0.01	0.04
LEAD (PB) *TOT	1.2	0.51						0.54				

* DIS - Dissolved

* TOT - Total

All quantities in mg/L unless otherwise noted

Blank line indicates parameter not tested.

1974-1980 - National Security and Defense
 1971-1972 - National Security and Defense
 1973-1974 - National Security and Defense
 1975-1976 - National Security and Defense

1970-1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098	2099	2100	2101	2102	2103	2104	2105	2106	2107	2108	2109	2110	2111	2112	2113	2114	2115	2116	2117	2118	2119	2120	2121	2122	2123	2124	2125	2126	2127	2128	2129	2130	2131	2132	2133	2134	2135	2136	2137	2138	2139	2140	2141	2142	2143	2144	2145	2146	2147	2148	2149	2150	2151	2152	2153	2154	2155	2156	2157	2158	2159	2160	2161	2162	2163	2164	2165	2166	2167	2168	2169	2170	2171	2172	2173	2174	2175	2176	2177	2178	2179	2180	2181	2182	2183	2184	2185	2186	2187	2188	2189	2190	2191	2192	2193	2194	2195	2196	2197	2198	2199	2200	2201	2202	2203	2204	2205	2206	2207	2208	2209	2210	2211	2212	2213	2214	2215	2216	2217	2218	2219	2220	2221	2222	2223	2224	2225	2226	2227	2228	2229	2230	2231	2232	2233	2234	2235	2236	2237	2238	2239	2240	2241	2242	2243	2244	2245	2246	2247	2248	2249	2250	2251	2252	2253	2254	2255	2256	2257	2258	2259	2260	2261	2262	2263	2264	2265	2266	2267	2268	2269	2270	2271	2272	2273	2274	2275	2276	2277	2278	2279	2280	2281	2282	2283	2284	2285	2286	2287	2288	2289	2290	2291	2292	2293	2294	2295	2296	2297	2298	2299	2300	2301	2302	2303	2304	2305	2306	2307	2308	2309	2310	2311	2312	2313	2314	2315	2316	2317	2318	2319	2320	2321	2322	2323	2324	2325	2326	2327	2328	2329	2330	2331	2332	2333	2334	2335	2336	2337	2338	2339	2340	2341	2342	2343	2344	2345	2346	2347	2348	2349	2350	2351	2352	2353	2354	2355	2356	2357	2358	2359	2360	2361	2362	2363	2364	2365	2366	2367	2368	2369	2370	2371	2372	2373	2374	2375	2376	2377	2378	2379	2380	2381	2382	2383	2384	2385	2386	2387	2388	2389	2390	2391	2392	2393	2394	2395	2396	2397	2398	2399	2400	2401	2402	2403	2404	2405	2406	2407	2408	2409	2410	2411	2412	2413	2414	2415	2416	2417	2418	2419	2420	2421	2422	2423	2424	2425	2426	2427	2428	2429	2430	2431	2432	2433	2434	2435	2436	2437	2438	2439	2440	2441	2442	2443	2444	2445	2446	2447	2448	2449	2450	2451	2452	2453	2454	2455	2456	2457	2458	2459	2460	2461	2462	2463	2464	2465	2466	2467	2468	2469	2470	2471	2472	2473	2474	2475	2476	2477	2478	2479	2480	2481	2482	2483	2484	2485	2486	2487	2488	2489	2490	2491	2492	2493	2494	2495	2496	2497	2498	2499	2500	2501	2502	2503	2504	2505	2506	2507	2508	2509	2510	2511	2512	2513	2514	2515	2516	2517	2518	2519	2520	2521	2522	2523	2524	2525	2526	2527	2528	2529	2530	2531	2532	2533	2534	2535	2536	2537	2538	2539	2540	2541	2542	2543	2544	2545	2546	2547	2548	2549	2550	2551	2552	2553	2554	2555	2556	2557	2558	2559	2560	2561	2562	2563	2564	2565	2566	2567	2568	2569	2570	2571	2572	2573	2574	2575	2576	2577	2578	2579	2580	2581	2582	2583	2584	2585	2586	2587	2588	2589	2590	2591	2592	2593	2594	2595	2596	2597	2598	2599	2600	2601	2602	2603	2604	2605	2606	2607	2608	2609	2610	2611	2612	2613	2614	2615	2616	2617	2618	2619	2620	2621	2622	2623	2624	2625	2626	2627	2628	2629	2630	2631	2632	2633	2634	2635	2636	2637	2638	2639	2640	2641	2642	2643	2644	2645	2646	2647	2648	2649	2650	2651	2652	2653	2654	2655	2656	2657	2658	2659	2660	2661	2662	2663	2664	2665	2666	2667	2668	2669	2670	2671	2672	2673	2674	2675	2676	2677	2678	2679	2680	2681	2682	2683	2684	2685	2686	2687	2688	2689	2690	2691	2692	2693	2694	2695	2696	2697	2698	2699	2700	2701	2702	2703	2704	2705	2706	2707	2708	2709	2710	2711	2712	2713	2714	2715	2716	2717	2718	2719	2720	2721	2722	2723	2724	2725	2726	2727	2728	2729	2730	2731	2732	2733	2734	2735	2736	2737	2738	2739	2740	2741	2742	2743	2744	2745	2746	2747	2748	2749	2750	2751	2752	2753	2754	2755	2756	2757	2758	2759	2760	2761	2762	2763	2764	2765	2766	2767	2768	2769	2770	2771	2772	2773	2774	2775	2776	2777	2778	2779	2780	2781	2782	2783	2784	2785	2786	2787	2788	2789	2790	2791	2792	2793	2794	2795	2796	2797	2798	2799	2800	2801	2802	2803	2804	2805	2806	2807	2808	2809	2810	2811	2812	2813	2814	2815	2816	2817	2818	2819	2820	2821	2822	2823	2824	2825	2826	2827	2828	2829	2830	2831	2832	2833	2834	2835	2836	2837	2838	2839	2840	2841	2842	2843	2844	2845	2846	2847	2848	2849	2850	2851	2852	2853	2854	2855	2856	2857	2858	2859	2860	2861	2862	2863	2864	2865	2866	2867	2868	2869	2870	2871	2872	2873	2874	2875	2876	2877	2878	2879	2880	2881	2882	2883	2884	2885	2886	2887	2888	2889	2890	2891	2892	2893	2894	2895	2896	2897	2898	2899	2900	2901	2902	2903	2904	2905	2906	2907	2908	2909	2910	2911	2912	2913	2914	2915	2916	2917	2918	2919	2920	2921	2922	2923	2924	2925	2926	2927	2928	2929	2930	2931	2932	2933	2934	2935	2936	2937	2938	2939	2940	2941	2942	2943	2944	2945	2946	2947	2948	2949	2950	2951	2952	2953	2954	2955	2956	2957	2958	2959	2960	2961	2962	2963	2964	2965	2966	2967	2968	2969	2970	2971	2972	2973	2974	2975	2976	2977	2978	2979	2980	2981	2982	2983	2984	2985	2986	2987	2988	2989	2990	2991	2992	2993	2994	2995	2996	2997	2998	2999	3000	3001	3002	3003	3004	3005	3006	3007	3008	3009	3010	3011	3012	3013	3014	3015	3016	3017	3018	3019	3020	3021	3022	3023	3024	3025	3026	3027	3028	3029	3030	3031	3032	3033	3034	3035	3036	3037	3038	3039	3040	3041	3042	3043	3044	3045	3046	3047	3048	3049	3050	3051	3052	3053	3054	3055	3056	3057	3058	3059	3060	3061	3062	3063	3064	3065	3066	3067	3068	3069	3070	3071	3072	3073	3074	3075	3076	3077	3078	3079	3080	3081	3082	3083	3084	3085	3086	3087	3088	3089	3090	3091	3092	3093	3094	3095	3096	3097	3098	3099	3100	3101	3102	3103	3104	3105	3106	3107	3108	3109	3110	3111	3112	3113	3114	3115	3116	3117	3118	3119	3120	3121	3122	3123	3124	3125	3126	3127	3128	3129	3130	3131	3132	3133	3134	3135	3136	3137	3138	3139	3140	3141	3142	3143	3144	3145	3146	3147	3148	3149	3150	3151	3152	3153	3154	3155	3156	3157	3158	3159	3160	3161	3162	3163	3164	3165	3166	3167	3168	3169	3170	3171	3172	3173	3174	3175	3176	3177	3178	3179	3180	3181	3182	3183	3184	3185	3186	3187	3188	3189	3190	3191	3192	3193	3194	3195	3196	3197	3198	3199	3200	3201	3202	3203	3204	3205	3206	3207	3208	3209	3210	3211	3212	3213	3214	3215	3216	3217	3218	3219	3220	3221	3222	3223	3224	3225	3226	3227	3228	3229	3230	3231	3232	3233	3234	3235	3236	3237	3238	3239	3240	3241	3242	3243	3244	3245	3246	3247	3248	3249	3250	3251	3252	3253	3254	3255	3256	3257	3258	3259	3260	3261	3262	3263	3264	3265	3266	3267	3268	3269	3270	3271	3272	3273	3274	3275	3276	3277	3278	3279	3280	3281	3282	3283	3284	3285	3286	3287	3288	3289	3290	3291	3292	3293	3294	3295	3296	3297	3298	3299	3300	3301	3302	3303	3304	3305	3306	3307	3308	3309	3310	3311	3312	3313	3314	3315	3316	3317	3318	3319	3320	3321	3322	3323	3324	3325	3326	3327	3328	3329	3330
-----------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	----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Table 2.3 - SUMMARY OF HELENA LANDFILL AREA WATER QUALITY

Client: CHHL01 - City of Helena

Project: Hlna Landfill Mtnng

Sample Type: Other Sites

SITE CODE	HL-1	HL-1	HL-4	HL-4	HL-5	HL-5	HL-5	HL-6	HL-6	HL-6	HL-6
SAMPLE DATE	10/20/88	05/25/89	09/09/80	06/30/82	09/09/80	06/30/82	06/30/82	04/07/86	09/10/80	06/30/82	04/07/86
LAB											
LAB NUMBER											
SAMPLE NUMBER	HYD-5801	HYD-5802	HYD-5781	HYD-5782	HYD-5783	HYD-5784	HYD-5785	HYD-5786	HYD-5794	HYD-5795	HYD-5796
-- TRACE ELEMENTS --											
MANGANESE (MN) *DIS							1.38				
MERCURY (HG) *DIS							<0.02				
MERCURY (HG) *TOT		0.002					<0.01				
MOLYBDENUM (MO) *DIS							0.01		0.0036		0.04
NICKEL (NI) *DIS								0.04			
NICKEL (NI) *TOT	0.45	0.1	0.0089		0.022						
SELENIUM (SE) *DIS							<0.05				
SILVER (AG) *DIS							<0.01				
VANADIUM (V) *DIS							<0.01				
ZINC (ZN) *DIS			0.0057		0.8		0.06		0.0069		0.09
ZINC (ZN) *TOT	2.9	0.76						1.6			

-- SEMI-VOLATILE EXTRACTABLES --
N-NITROSO-DI-N-BUTYLAMINE (ppb)

* DIS - Dissolved

* TOT - Total

All quantities in mg/L unless otherwise noted.
Blank line indicates parameter not tested.

Table 2.3 - SUMMARY OF HELENA LANDFILL AREA WATER QUALITY
Client: CHH01 - City of Helena
Project: Hlna Landfill Mtrng

Sample Type: Other Sites

SITE CODE	HL-7	HL-7	HL-7	HL-7	HL-7	HL-7	HL-7	HL-90-1	HL-90-1	HL-90-1DUP	HL-90-2	HL-90-2	HL-90-1A
SAMPLE DATE	09/09/80	06/30/82	04/07/86	06/15/87	10/20/88	05/25/89	05/11/90	04/05/91	04/05/91	04/05/91	05/10/90	04/04/91	02/02/90
LAB NUMBER								EL	EL	EL	EL	EL	EL
REMARKS								91-12771	91-12772	91-12772	90-12197	91-12767	2766
SAMPLE NUMBER	HYD-5787	HYD-5788	HYD-5789	HYD-5790	HYD-5791	HYD-5792	HYD-5752	HL9104-108	HL9104-108	HL9104-118	HYD-5761	HL9104-104	HYD-5748
PH	6	7.6	820	910	1000	950	7.7	7.6	7.8	7.8	7.8	7.8	7.8
SPEC. COND. (UMHOS/CM)	620	797					687	678					1100
TDS MEAS. @ 180 DEG. C													685
TOTAL DISS. SOLIDS MEAS.	394	4800											
TURBIDITY													
-- COMMON IONS --													
TOTAL HARDNESS AS CaCO3			410	550	600	530		144	145				528
CALCIUM (CA)		108						48	48				137
CALCIUM (CA) *DIS		31						38	37				45
MAGNESIUM (MG)		28											35
MAGNESIUM (MG) *DIS	22												
SODIUM (NA)													
SODIUM (NA) *DIS	3	6	26	30	13	34	5	4	4			3	3
SODIUM (NA) *TOT													395
POTASSIUM (K)													
POTASSIUM (K) *DIS								402	399				
TOTAL ALKALINITY AS CaCO3			220	250	470	360		491	487				482
ALKALINITY AS CaCO3	181	330						0	0				
BICARBONATE (HCO3)													
CARBONATE AS CaCO3		0											0
CARBONATE AS CO3		125											132
SULFATE (SO4)	100	34	39	40	24	46	140	141	141				31
CHLORIDE (CL)							33	33	33				
-- NUTRIENTS --													
AMMONIA (NH3 AS N)													
NITRATE (NO3-N)	1.06	9	6.6	7.6	1.8	5.5	<0.1	7.53	<0.1				8.4
NITRATE + NITRITE AS N													
-- TRACE ELEMENTS --													
ARSENIC (AS)													
BARIUM (BA)													
CADMIUM (CD)													
CADMIUM (CD) *DIS	0.0007		0.004	0.008	0.01	0.002	<0.005	<0.1	<0.1				0.005
CADMIUM (CD) *TOT							0.001	0.001	0.001				
CHROMIUM (CR)													

* DIS - Dissolved
* TOT - Total
All quantities in mg/L unless otherwise noted
Blank line indicates parameter not tested.

1975, Nov. 12-13
 1975, Nov. 14-15
 1975, Nov. 16-17
 1975, Nov. 18-19
 1975, Nov. 20-21
 1975, Nov. 22-23
 1975, Nov. 24-25
 1975, Nov. 26-27
 1975, Nov. 28-29
 1975, Nov. 30-31

1976, Jan. 1-2
 1976, Jan. 3-4
 1976, Jan. 5-6
 1976, Jan. 7-8
 1976, Jan. 9-10
 1976, Jan. 11-12
 1976, Jan. 13-14
 1976, Jan. 15-16
 1976, Jan. 17-18
 1976, Jan. 19-20
 1976, Jan. 21-22
 1976, Jan. 23-24
 1976, Jan. 25-26
 1976, Jan. 27-28
 1976, Jan. 29-30
 1976, Jan. 31-31

1976, Feb. 1-2
 1976, Feb. 3-4
 1976, Feb. 5-6
 1976, Feb. 7-8
 1976, Feb. 9-10
 1976, Feb. 11-12
 1976, Feb. 13-14
 1976, Feb. 15-16
 1976, Feb. 17-18
 1976, Feb. 19-20
 1976, Feb. 21-22
 1976, Feb. 23-24
 1976, Feb. 25-26
 1976, Feb. 27-28
 1976, Feb. 29-30
 1976, Feb. 31-31

1976, Mar. 1-2
 1976, Mar. 3-4
 1976, Mar. 5-6
 1976, Mar. 7-8
 1976, Mar. 9-10
 1976, Mar. 11-12
 1976, Mar. 13-14
 1976, Mar. 15-16
 1976, Mar. 17-18
 1976, Mar. 19-20
 1976, Mar. 21-22
 1976, Mar. 23-24
 1976, Mar. 25-26
 1976, Mar. 27-28
 1976, Mar. 29-30
 1976, Mar. 31-31

1976, Apr. 1-2
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 1976, Apr. 7-8
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 1976, Apr. 11-12
 1976, Apr. 13-14
 1976, Apr. 15-16
 1976, Apr. 17-18
 1976, Apr. 19-20
 1976, Apr. 21-22
 1976, Apr. 23-24
 1976, Apr. 25-26
 1976, Apr. 27-28
 1976, Apr. 29-30
 1976, Apr. 31-31

1976, May 1-2
 1976, May 3-4
 1976, May 5-6
 1976, May 7-8
 1976, May 9-10
 1976, May 11-12
 1976, May 13-14
 1976, May 15-16
 1976, May 17-18
 1976, May 19-20
 1976, May 21-22
 1976, May 23-24
 1976, May 25-26
 1976, May 27-28
 1976, May 29-30
 1976, May 31-31

1976, Jun. 1-2
 1976, Jun. 3-4
 1976, Jun. 5-6
 1976, Jun. 7-8
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 1976, Jun. 11-12
 1976, Jun. 13-14
 1976, Jun. 15-16
 1976, Jun. 17-18
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 1976, Jun. 21-22
 1976, Jun. 23-24
 1976, Jun. 25-26
 1976, Jun. 27-28
 1976, Jun. 29-30
 1976, Jun. 31-31

1976, Jul. 1-2
 1976, Jul. 3-4
 1976, Jul. 5-6
 1976, Jul. 7-8
 1976, Jul. 9-10
 1976, Jul. 11-12
 1976, Jul. 13-14
 1976, Jul. 15-16
 1976, Jul. 17-18
 1976, Jul. 19-20
 1976, Jul. 21-22
 1976, Jul. 23-24
 1976, Jul. 25-26
 1976, Jul. 27-28
 1976, Jul. 29-30
 1976, Jul. 31-31

1976, Aug. 1-2
 1976, Aug. 3-4
 1976, Aug. 5-6
 1976, Aug. 7-8
 1976, Aug. 9-10
 1976, Aug. 11-12
 1976, Aug. 13-14
 1976, Aug. 15-16
 1976, Aug. 17-18
 1976, Aug. 19-20
 1976, Aug. 21-22
 1976, Aug. 23-24
 1976, Aug. 25-26
 1976, Aug. 27-28
 1976, Aug. 29-30
 1976, Aug. 31-31

1976, Sep. 1-2
 1976, Sep. 3-4
 1976, Sep. 5-6
 1976, Sep. 7-8
 1976, Sep. 9-10
 1976, Sep. 11-12
 1976, Sep. 13-14
 1976, Sep. 15-16
 1976, Sep. 17-18
 1976, Sep. 19-20
 1976, Sep. 21-22
 1976, Sep. 23-24
 1976, Sep. 25-26
 1976, Sep. 27-28
 1976, Sep. 29-30
 1976, Sep. 31-31

1976, Oct. 1-2
 1976, Oct. 3-4
 1976, Oct. 5-6
 1976, Oct. 7-8
 1976, Oct. 9-10
 1976, Oct. 11-12
 1976, Oct. 13-14
 1976, Oct. 15-16
 1976, Oct. 17-18
 1976, Oct. 19-20
 1976, Oct. 21-22
 1976, Oct. 23-24
 1976, Oct. 25-26
 1976, Oct. 27-28
 1976, Oct. 29-30
 1976, Oct. 31-31

1976, Nov. 1-2
 1976, Nov. 3-4
 1976, Nov. 5-6
 1976, Nov. 7-8
 1976, Nov. 9-10
 1976, Nov. 11-12
 1976, Nov. 13-14
 1976, Nov. 15-16
 1976, Nov. 17-18
 1976, Nov. 19-20
 1976, Nov. 21-22
 1976, Nov. 23-24
 1976, Nov. 25-26
 1976, Nov. 27-28
 1976, Nov. 29-30
 1976, Nov. 31-31

1976, Dec. 1-2
 1976, Dec. 3-4
 1976, Dec. 5-6
 1976, Dec. 7-8
 1976, Dec. 9-10
 1976, Dec. 11-12
 1976, Dec. 13-14
 1976, Dec. 15-16
 1976, Dec. 17-18
 1976, Dec. 19-20
 1976, Dec. 21-22
 1976, Dec. 23-24
 1976, Dec. 25-26
 1976, Dec. 27-28
 1976, Dec. 29-30
 1976, Dec. 31-31

1977, Jan. 1-2
 1977, Jan. 3-4
 1977, Jan. 5-6
 1977, Jan. 7-8
 1977, Jan. 9-10
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 1977, Jan. 29-30
 1977, Jan. 31-31

1977, Feb. 1-2
 1977, Feb. 3-4
 1977, Feb. 5-6
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 1977, Feb. 11-12
 1977, Feb. 13-14
 1977, Feb. 15-16
 1977, Feb. 17-18
 1977, Feb. 19-20
 1977, Feb. 21-22
 1977, Feb. 23-24
 1977, Feb. 25-26
 1977, Feb. 27-28
 1977, Feb. 29-30
 1977, Feb. 31-31

Table 2.3 - SUMMARY OF HELENA LANDFILL AREA WATER QUALITY

Client: CHHL01 - City of Helena
Project: Helena Landfill Mtng

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Sample Type: Other Sites

SITE CODE	HL-7	HL-7	HL-7	HL-7	HL-7	HL-7	HL-7	HL-90-1	HL-90-1	HL-90-2	HL-90-2	HL-90-2	HL-90-1A
SAMPLE DATE	09/09/80	06/30/82	04/07/86	06/15/87	10/20/88	05/25/89	05/11/90	04/05/91	04/05/91	05/10/90	04/04/91	02/02/90	
LAB													
LAB NUMBER													
REMARKS													
SAMPLE NUMBER	HYD-5787	HYD-5788	HYD-5789	HYD-5790	HYD-5791	HYD-5792	HYD-5752	HL9104-108	HL9104-118	HYD-5761	HL9104-104	HYD-5748	
-- TRACE ELEMENTS --													
CHROMIUM (CR) *DIS	0.018												
CHROMIUM (CR) *TOT													
COPPER (CU) *DIS	0.037												
COPPER (CU) *TOT			0.07	0.13	0.18	0.06							
IRON (FE)													
IRON (FE) *DIS		9.09		0.04									
LEAD (PB)													
LEAD (PB) *DIS													
LEAD (PB) *TOT	0.062	<0.01											
MANGANESE (MN)													
MERCURY (HG)													
MERCURY (HG) *TOT													
NICKEL (NI) *DIS													
NICKEL (NI) *TOT	0.0074		0.01	0.08	0.12	0.01							
SELENIUM (SE)													
SILVER (AG)													
ZINC (ZN) *DIS	0.28		0.05	0.27	0.36	0.1							
ZINC (ZN) *TOT													
-- VOLATILE ORGANICS --													
1,1,1-TRICHLOROETHANE (ppb)								7	6.6		1		
1,1,2,2-TETRACHLOROETHANE (ppb)								<1	<1		<1		
1,1,2-TRICHLOROETHANE (ppb)								<1	<1		<1		
1,1-DICHLOROETHANE (ppb)								2.9	2.8		2.2		
1,1-DICHLOROETHENE (ppb)								<0.5	<0.5		<0.5		
1,2-DICHLOROETHANE (ppb)								0.5	0.5		<0.5		
BENZENE (ppb)								<0.5	<0.5		<0.5		
BROMOCHLOROMETHANE (ppb)								<1	<1		<1		
BROMODICHLOROMETHANE (ppb)								<1	<1		<1		
BROMOFORM (ppb)								<1	<1		<1		
BROMOMETHANE (ppb)								<1	<1		<1		
CARBON TETRACHLORIDE (ppb)								<0.5	<0.5		<0.5		
CHLOROBENZENE (ppb)								<1	<1		<1		
CHLOROETHANE (ppb)								<1	<1		<1		
CHLOROFORM (ppb)								4.1	3.9		<1		
CHLOROMETHANE (ppb)								<1	<1		<1		
CIS-1,3-DICHLOROPROPENE (ppb)								<1	<1		<1		

* DIS - Dissolved

* TOT - Total

All quantities in mg/L unless otherwise noted
Blank line indicates parameter not tested.

Table 2.3 - SUMMARY OF HELENA LANDFILL AREA WATER QUALITY

Client: CHHLO1 - City of Helena
Project: Helena Landfill Mtrng

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Sample Type: Other Sites

SITE CODE	HL-7	HL-7	HL-7	HL-7	HL-7	HL-7	HL-90-1	HL-90-1	HL-90-10UP	HL-90-2	HL-90-2	HL-90-1A
SAMPLE DATE	09/09/80	06/30/82	04/07/86	06/15/87	10/20/88	05/25/89	05/11/90	04/05/91	04/05/91	05/10/90	04/04/91	02/02/90
LAB							EL	EL	EL	EL	EL	EL
LAB NUMBER							90-12198	91-12771	91-12772	90-12197	91-12767	2766
REMARKS							Helena Landfi	Helena Landfi	Helena Landfi		Helena Landfi	
SAMPLE NUMBER	HYD-5787	HYD-5788	HYD-5789	HYD-5790	HYD-5791	HYD-5792	HYD-5752	HL9104-108	HL9104-118	HYD-5761	HL9104-104	HYD-5748
-- VOLATILE ORGANICS --												
DIBROMOCHLOROMETHANE (ppb)								<1	<1		<1	
DIBROMOMETHANE (ppb)								<1	<1		<1	
DICHLORO-DIFLUOROMETHANE (ppb)								8.9	8.8		<1	
ETHYLBENZENE (ppb)								<1	<1		<1	
XYLENE (ppb)								<1	<1		<1	
METHYLENE CHLORIDE (ppb)								3.6	3.5		<1	
TETRACHLOROETHENE (ppb)								12	13		<0.5	
TOLUENE (ppb)								<1	<1		<1	
TRANS-1,2-DICHLOROETHENE (ppb)								<1	<1		<1	
TRANS-1,3-DICHLOROPROPENE (ppb)								<1	<1		<1	
TRICHLOROETHENE (ppb)								2.2	2.2		<0.5	
TRICHLOROFLUOROMETHANE (ppb)								2.8	2.6		<1	
VINYL CHLORIDE (ppb)								<0.5	<0.5		<0.5	
-- SEMI-VOLATILE EXTRACTABLES --												
1,2,3-TRICHLOROPROPANE (ppb)								<1	<1		<1	
1,2,4-TRICHLOROBENZENE (ppb)										<10		
1,2-DICHLOROBENZENE (ppb)										<10		
1,3-DICHLOROBENZENE (ppb)										<10		
1,4-DICHLOROBENZENE (ppb)										<10		
2-METHYL-4,6-DINITROPHENO (ppb)										<50		
2,4,6-TRICHLOROPHENOL (ppb)										<10		
2,4-DICHLOROPHENOL (ppb)										<10		
2,4-DIMETHYLPHENOL (ppb)										<10		
2,4-DINITROPHENOL (ppb)										<10		
2,6-DINITROPHENOL (ppb)										<10		
2-CHLORONAPHTHALENE (ppb)										<10		
2-CHLOROPHENOL (ppb)										<10		
2-NITROPHENOL (ppb)										<10		
3,3-DICHLOROBENZIDINE (ppb)										<10		
4-BROMOPHENYL PHENYL ETHER (ppb)										<10		
4-CHLORO-3-METHYLPHENOL (ppb)										<10		
4-CHLOROPHENYL PHENYL ETHER (ppb)										<10		
4-NITROPHENOL (ppb)										<10		
ACENAPHTHENE (ppb)										<50		
ACENAPHTHYLENE (ppb)										<10		

* DIS - Dissolved

* TOT - Total

All quantities in mg/L unless otherwise noted
Blank line indicates parameter not tested.

Table 2.3 - SUMMARY OF HELENA LANDFILL AREA WATER QUALITY

Client: CHHL01 - City of Helena
Project: Hlna Landfill Mtrng

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07/16/91

Sample Type: Other Sites

SITE CODE	HL-7	HL-7	HL-7	HL-7	HL-7	HL-7	HL-90-1	HL-90-1	HL-90-1	HL-90-10UP	HL-90-2	HL-90-2	HL-90-1A
SAMPLE DATE	09/09/80	06/30/82	04/07/86	06/15/87	10/20/88	05/25/89	05/11/90	04/05/91	04/05/91	04/05/91	05/10/90	04/04/91	02/02/90
LAB							EL	EL	EL	EL	EL	EL	EL
LAB NUMBER							90-12198	91-12771	91-12772	91-12772	90-12197	91-12767	2766
REMARKS							Helena Landfi	Helena Landfi	Helena Landfi	Helena Landfi		Helena Landfi	
SAMPLE NUMBER	HYD-5787	HYD-5788	HYD-5789	HYD-5790	HYD-5791	HYD-5792	HYD-5752	HL9104-108	HL9104-118	HYD-5761		HL9104-104	HYD-5748
-- SEMI-VOLATILE EXTRACTABLES --													
ANTHRACENE (ppb)							<10				<10		
AZOBENZENE (1,2-DIPHENYLHYDRAZIN							<10				<10		
BENZIDINE (ppb)							<10				<10		
BENZO (A) ANTHRACENE (ppb)							<10				<10		
BENZO (A) PYRENE (ppb)							<10				<10		
BENZO (B) FLUORANTHENE (ppb)							<10				<10		
BENZO (GH) PERYLENE (ppb)							<10				<10		
BENZO (K) FLUORANTHENE (ppb)							<10				<10		
BIS (2-CHLOROETHOXY) METHANE (pp							<10				<10		
BIS (2-CHLOROETHYL) ETHER (ppb)							<10				<10		
BIS (2-CHLOROISOPROPYL) ETHER (p							<10				<10		
BIS (2-ETHYLHEXYL) PHTHALATE (pp							<10				<10		
BUTYL BENZYL PHTHALATE (ppb)							<10				<10		
CHRYSENE (ppb)							<10				<10		
DI-N-BUTYLPHTHALATE (ppb)							<10				<10		
DI-N-OCTYL PHTHALATE (ppb)							<10				<10		
DIBENZO (A,H) ANTHRACENE (ppb)							<10				<10		
DIETHYLPHTHALATE (ppb)							<10				<10		
DIMETHYLPHTHALATE (ppb)							<10				<10		
FLUORANTHENE (ppb)							<10				<10		
FLUORENE (ppb)							<10				<10		
HEXACHLOROBENZENE (ppb)							<10				<10		
HEXACHLOROBUTADIENE (ppb)							<10				<10		
HEXACHLOROETHANE (ppb)							<10				<10		
INDENO (1,2,3-CD) PYRENE (ppb)							<10				<10		
ISOPHORONE (ppb)							<10				<10		
N-NITROSO-DI-N-BUTYLAMINE (ppb)							<10				<10		
N-NITROSO-DI-N-PROPYLAMINE (ppb)							<10				<10		
N-NITROSO-PHENYLAMINE (ppb)							<10				<10		
NAPHTHALENE (ppb)							<10				<10		
NITROBENZENE (ppb)							<10				<10		
PENTACHLOROPHENOL (ppb)							<10				<10		
PHENANTHRENE (ppb)							<10				<10		
PHENOL (ppb)							<10				<10		
PYRENE (ppb)							<10				<10		
	126	197											

-- HYDROCARBONS --

ORGANIC CARBON (TOTAL)

* DIS - Dissolved

* TOT - Total

All quantities in mg/L unless otherwise noted

Blank line indicates parameter not tested.

<2

2

Table 2.3 - SUMMARY OF HELENA LANDFILL AREA WATER QUALITY
Client: CHL01 - City of Helena
Project: Hlna Landfill Mtrng

Sample Type: Other Sites							
SITE CODE	HL-7	HL-7	HL-7	HL-7	HL-7	HL-90-1	HL-90-2
SAMPLE DATE	09/09/80	06/30/82	04/07/86	06/15/87	10/20/88	05/11/90	05/10/90
LAB						EL	EL
LAB NUMBER						90-12198	90-12197
REMARKS						Helena Landfi	Helena Landfi
SAMPLE NUMBER	HYD-5787	HYD-5788	HYD-5789	HYD-5790	HYD-5791	HYD-5752	HYD-5761
						HL9104-108	HL9104-104
						2	<1

-- OTHER PARAMETERS --
CYANIDE (CN)
CHEMICAL OXGEN DEMAND

* DIS - Dissolved
* TOT - Total
All quantities in mg/L unless otherwise noted
Blank line indicates parameter not tested.

Table 2.3 - SUMMARY OF HELENA LANDFILL AREA WATER QUALITY
Client: CHHL01 - City of Helena
Project: Hlna Landfill Mtrng

Sample Type: Other Sites

SITE CODE	HL90-2A	HL90-3	HL90-3	HL90-3A	J-3	LCG-1	LCG-1	MA-1	MA-7	POND	W-1	W-1
SAMPLE DATE	02/03/90	02/02/90	04/05/91	02/02/90	05/08/90	09/09/80	06/30/82	11/13/89	11/11/89	05/06/90	04/03/90	05/06/90
LAB	EL	EL	EL	EL	EL			EL	EL	EL	EL	EL
LAB NUMBER	2767	90-2765	91-12770	2765	90-12196			89-20185	89-20182	90-10828	90-7837	90-10827
REMARKS			Helena Landfi									
SAMPLE NUMBER	HYD-5756	HYD-5749	HL9104-107	HYD-5762	HYD-5759	HYD-5727	HYD-5728	HYD-5753	HYD-5760	HYD-5740	HYD-5737	HYD-5738
-- PHYSICAL PARAMETERS --												
PH	7.9		7.7	7.5		6.5	8.2					
PH (pH units)												
SPEC. COND. (UMHOS/CM)	877		662	1130		380	492					
TDS MEAS. @ 180 DEG. C	511			686		309						
TOTAL DISS. SOLIDS MEAS.							1.5					
TURBIDITY												
-- COMMON IONS --												
TOTAL HARDNESS AS CaCO3	444			435			63					
CALCIUM (CA)				109			21					
CALCIUM (CA) *DIS	121		108									
MAGNESIUM (MG)				40		5	8					
MAGNESIUM (MG) *DIS	35		39									
SODIUM (NA)				80		1.6	4					
SODIUM (NA) *DIS	23		83									
POTASSIUM (K)				3								
POTASSIUM (K) *DIS	3		4									
TOTAL ALKALINITY AS CaCO3	367		393	400		163	261					
ALKALINITY AS CaCO3							0					
BICARBONATE (HCO3)	448		479	488								
CARBONATE AS CO3	0		0	0								
SULFATE (SO4)	62		134	136		35	44					
CHLORIDE (CL)	32		29	30			<1					
-- NUTRIENTS --												
NITRATE (NO3-N)												
NITRATE + NITRITE AS N	0.9		6.91	5.7		1.14	1.62					
NITROGEN AS N			<0.1									
-- TRACE ELEMENTS --												
ARSENIC (AS) *DIS			<0.005									
BARIUM (BA) *DIS			<0.1									
CADMIUM (CD) *DIS	0.005		0.002	0.006		0.01						
CHROMIUM (CR) *DIS			<0.02			0.015						
COPPER (CU) *DIS	<0.01		<0.01	<0.01		0.0036						
IRON (FE) *DIS	0.06		<0.03	<0.03			1.2					
LEAD (PB) *DIS	<0.01		<0.01	<0.01		0.08	<0.01					

* DIS - Dissolved

* TOT - Total

All quantities in mg/L unless otherwise noted
Blank line indicates parameter not tested.

Table 2.3 - SUMMARY OF HELENA LANDFILL AREA WATER QUALITY
Client: CHIL01 - City of Helena
Project: Helena Landfill Mtrng

Sample Type: Other Sites

SITE CODE	HL90-2A	HL90-3	HL90-3A	I-3	LOG-1	LOG-1	MA-1	MA-7	POND	W-1	W-1
SAMPLE DATE	02/03/90	02/02/90	04/05/91	05/08/90	06/30/82	09/09/80	11/13/89	11/11/89	05/06/90	04/03/90	05/06/90
LAB	EL	EL	EL	EL			EL	EL	EL	EL	EL
LAB NUMBER	2767	90-2765	91-12770	90-12196			89-20185	89-20182	90-10828	90-7837	90-10827
REMARKS		Helena Landfi									
SAMPLE NUMBER	HYD-5756	HYD-5749	HYD-5762	HYD-5759	HYD-5727	HYD-5728	HYD-5753	HYD-5760	HYD-5740	HYD-5737	HYD-5738
-- TRACE ELEMENTS --											
MANGANESE (MN) *DIS											
MERCURY (HG) *DIS			<0.02								
NICKEL (NI) *DIS			<0.001		0.77						
SELENIUM (SE) *DIS			<0.005								
SILVER (AG) *DIS			<0.005								
ZINC (ZN) *DIS	0.02		0.02								
-- VOLATILE ORGANICS --											
1,1,1,2-TETRACHLOROETHANE (ppb)	<1	<1	<1	<1			<1	<1	<1	<1	<1
1,1,1,1-TRICHLOROETHANE (ppb)	<0.5	<0.5	<0.5	2.6			<0.50 *	7.1	<0.5	0.96	<0.5
1,1,2,2-TETRACHLOROETHANE (ppb)	<1	<1	<1	<1			<1	<1	<1	<1	<1
1,1,1,2-TRICHLOROETHANE (ppb)	<1	<1	<1	<1			<1	<1	<1	<1	<1
1,1-DICHLOROETHANE (ppb)	1.1	<1	<1	1.7			<1	5.8	<1	<1	<1
1,1-DICHLOROPROPENE (ppb)	<0.5	<0.5	<0.5	<0.50 *			<0.5	<0.5	<0.5	<0.5	<0.5
1,1-DICHLOROPROPANE (ppb)	<1	<1	<1	<1			<1	<1	<1	<1	<1
1,2-DIBROMOETHANE (ppb)	<1	<1	<1	<1			<0.05	<0.5	<0.5	<0.5	<0.5
1,2-DICHLOROETHANE (ppb)	<0.5	<0.5	<0.5	<0.5			<1	<1	<1	<1	<1
1,2-DICHLOROPROPANE (ppb)	<1	<1	<1	<1			<1	<1	<1	<1	<1
2,2-DICHLOROPROPANE (ppb)	<1	<1	<1	<1			<1	<1	<1	<1	<1
2-CHLOROTOLUENE (ppb)	<1	<1	<1	<1			<1	<1	<1	<1	<1
4-CHLOROTOLUENE (ppb)	<1	<1	<1	<1			<1	<1	<1	<1	<1
BENZENE (ppb)	<0.5	<0.5	<0.5	<0.5			<0.5	<0.5	<0.5	<0.5	<0.5
BROMOBENZENE (ppb)	<1	<1	<1	1			<1	<1	<1	<1	<1
BROMOCHLOROMETHANE (ppb)	<1	<1	<1	<1			<1	<1	<1	<1	<1
BROMODICHLOROMETHANE (ppb)	<1	<1	<1	<1			<1	<1	<1	<1	<1
BROMOFORM (ppb)	<1	<1	<1	<1			<1.0 *	<1	<1	<1	<1.0 *
BROMOMETHANE (ppb)	<1	<1	<1	<1			<1	<1	<1	<1	<1
CARBON TETRACHLORIDE (ppb)	<0.5	<0.5	<0.5	<0.5			<0.5	<0.5	<0.5	<0.5	<0.5
CHLOROBENZENE (ppb)	<1	<1	<1	<1			<1	<1	<1	<1	<1
CHLOROETHANE (ppb)	<1	<1	<1	<1			<1	<1	<1	<1	<1
CHLOROFORM (ppb)	5.5	<1	5.8	3.8			<1	<1	<1	<1	<1
CHLOROMETHANE (ppb)	<1	<1	<1	<1			3.5	2.3	<1	<1.0 *	7.9
CIS-1,2-DICHLOROETHENE (ppb)	1.8	<1	<1	1.1			<1	<1	<1	<1	<1
CIS-1,3-DICHLOROPROPENE (ppb)	<1	<1	<1	<1			<1	<1	<1	<1	<1
CIS-1,3-DICHLOROPROPYLENE (ppb)	<1.0 *	<1.0 *	<1	3.9			<1	6.3	<1	<1	<1.0 *
DIBROMOCHLOROMETHANE (ppb)	<1	<1	<1	<1			<1	<1	<1	<1	<1
DIBROMOMETHANE (ppb)	<1	<1	<1	<1			<1	<1	<1	<1	<1

* DIS - Dissolved

* TOT - Total

All quantities in mg/L unless otherwise noted

Blank line indicates parameter not tested.

Table 2.3 - SUMMARY OF HELENA LANDFILL AREA WATER QUALITY
Client: CHHL01 - City of Helena
Project: Helena Landfill Mtnng

Sample Type: Other Sites			
SITE CODE	HL90-2A	HL90-3	HL90-3A
SAMPLE DATE	02/03/90	02/02/90	02/02/90
LAB	EL	EL	EL
LAB NUMBER	2767	90-2765	2765
REMARKS	HYD-5756	HYD-5749	HYD-5762
SAMPLE NUMBER			
		HL90-3 04/05/91 EL 91-12770 Helena Landfi HL9104-107	I-3 05/08/90 EL 90-12196 HYD-5759
		LCG-1 09/09/80 HYD-5727	LCG-1 06/30/82 HYD-5728
		MM-1 11/13/89 EL 89-20185 HYD-5753	MM-7 11/11/89 EL 89-20182 HYD-5760
		POND 05/06/90 EL 90-10828 HYD-5740	U-1 04/03/90 EL 90-7837 HYD-5737
			U-1 05/06/90 EL 90-10827 HYD-5738

-- OTHER PARAMETERS --
CYANIDE (CN) *TOT
CHEMICAL OXIGEN DEMAND
3
<0.005

* DIS - Dissolved
* TOT - Total
All quantities in mg/L unless otherwise noted
Blank line indicates parameter not tested.

Table 2.3 - SUMMARY OF HELENA LANDFILL AREA WATER QUALITY

Client: CHHL01 - City of Helena

Project: Hlna Landfill Mtnng

Sample Type: Other Sites

SITE CODE	W-5	W-6	W-6	W-6	W-82-2	W-82-4	W-82-4	W-83-7	W-GC1
SAMPLE DATE	05/06/90	05/06/90	05/06/90	05/06/90	11/11/89	11/11/89	11/11/89	11/11/89	04/03/90
LAB	EL	EL	EL	EL	EL	EL	EL	EL	
LAB NUMBER	90-10829	90-10830	90-10830	90-10830	89-20181	89-20180	90-12199	89-20183	7837
REMARKS		DUPLICATE							
SAMPLE NUMBER	HYD-5741	HYD-5774	HYD-5775	HYD-5754	HYD-5754	HYD-5743	HYD-5744	HYD-5771	HYD-5780

-- PHYSICAL PARAMETERS --

SPEC. COND. (UMHOS/CM) PH

-- COMMON IONS --

TOTAL HARDNESS AS CaCO_3	
CALCIUM (CA) *D1S	
MAGNESIUM (MG) *D1S	
SODIUM (NA) *D1S	
POTASSIUM (K) *D1S	
BICARBONATE (HCO_3)	
CARBONATE AS CO_3	
SULFATE (SO_4)	
CHLORIDE (CL)	

-- NUTRIENTS --

NITRATE + NITRITE AS N

-- TRACE ELEMENTS --

CADMIUM (CD) *DIS
COPPER (CU) *DIS
IRON (FE) *DIS
LEAD (PB) *DIS
ZINC (ZN) *DIS

-- VOLATILE ORGANICS --

1,1,1,1,2-TETRACHLOROETHANE (pbb)
1,1,1-TRICHLOROETHANE (pbb)
1,1,2,2-TETRACHLOROETHANE (pbb)
1,1,2-TRICHLOROETHANE (pbb)
1,1-DICHLOROETHANE (pbb)
1,1-DICHLOROETHENE (pbb)
1,1-DICHLOROPROPENE (pbb)
1,2-DIBROMOETHANE (pbb)
1,2-DICHLOROETHANE (pbb)
1,2-DICHLOROPROPANE (pbb)
2,2-DICHLOROPROPANE (pbb)
2-CHLOROTOLUENE (pbb)

* PIS - Dissolved

* TOT - Total

All quantities in mg/L unless otherwise noted
Blank line indicates parameter not tested.

Table 2.3 - SUMMARY OF HELENA LANDFILL AREA WATER QUALITY
Client: CHHLO1 - City of Helena
Project: Helena Landfill Mtnng

Sample Type: Other Sites

SITE CODE	W-5	W-6	W-6	W-82-2	W-82-4	W-82-4	W-83-7	W-83-7
SAMPLE DATE	05/06/90	05/06/90	05/06/90	11/11/89	11/11/89	05/11/90	11/11/89	04/03/90
LAB	EL	EL	EL	EL	EL	EL	EL	EL
LAB NUMBER	90-10829	90-10830	90-10830	89-20181	89-20180	90-12199	89-20183	7837
REMARKS		DUPLICATE						
SAMPLE NUMBER	HYD-5741	HYD-5774	HYD-5775	HYD-5754	HYD-5743	HYD-5744	HYD-5771	HYD-5780
-- VOLATILE ORGANICS --								
4-CHLOROTOLUENE (ppb)	<1	<1	<1	<1	<1		<1	
BENZENE (ppb)	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5	
BROMOBENZENE (ppb)	<1	<1	<1	<1	<1		<1	
BROMOCHLOROMETHANE (ppb)	<1	<1	<1	<1	<1		<1	
BROMODICHLOROMETHANE (ppb)	<1	<1	<1	<1	<1		<1	
BROMOFORM (ppb)	<1	<1	<1	<1	<1		<1	
BROMOMETHANE (ppb)	<1	<1	<1	<1	<1		<1	
CARBON TETRACHLORIDE (ppb)	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5	
CHLOROBENZENE (ppb)	<1	<1	<1	<1	<1		<1	
CHLOROETHANE (ppb)	<1	<1	<1	<1	<1		<1	
CHLOROFORM (ppb)	2.3	2	2	<1	<1.0 *		4.4	
CIS-1,2-DICHLOROETHENE (ppb)	<1	<1	<1	<1	<1		<1	
CIS-1,3-DICHLOROPROPENE (ppb)	<1	<1	<1	<1	<1		<1	
CIS-1,3-DICHLOROPROPYLENE (ppb)	<1.0 *	<1	<1	<1	33		<1.0 *	
DIBROMOCHLOROMETHANE (ppb)	<1	<1	<1	<1	<1		<1	
DIBROMOMETHANE (ppb)	<1	<1	<1	<1	67		<1.0 *	
DICHLORODIFLUOROMETHANE (ppb)	1	<1	<1	<1	<1		<1	
ETHYLBENZENE (ppb)	<1	<1	<1	<1	<1		<1	
XYLENE (ppb)	<1	<1	<1	<1	<1		<1	
M-P XYLENE (ppb)	<1	<1	<1	<1	<1		<1	
O-XYLENE (ppb)	<1	<1	<1	<1	<1		<1	
METHYLENE CHLORIDE (ppb)	<1	<1	<1	<1	7.5		<1.0 *	
STYRENE (ppb)	<1	<1	<1	<1	<1		<1	
TETRACHLOROETHENE (ppb)	<0.50 *	<0.5	<0.5	<0.5	4.8		<0.5	
TOLUENE (ppb)	<1	<1	<1	<1	<1		<1	
TRANS-1,2-DICHLOROETHENE (ppb)	<1	<1	<1	<1	<1		<1	
TRANS-1,3-DICHLOROPROPENE (ppb)	<1	<1	<1	<1	<1		<1	
TRICHLOROETHENE (ppb)	<0.5	<0.5	<0.5	<0.5	2.9		<0.5	
TRICHLOROFLUOROMETHANE (ppb)	<1	<1	<1	<1	40		<1	
VINYL CHLORIDE (ppb)	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5	
-- SEMI-VOLATILE EXTRACTABLES --								
1,2,3-TRICHLOROBENZENE (ppb)	<1	<1	<1	<1	<1		<1	
1,2,3-TRICHLOROPROPANE (ppb)	<1	<1	<1	<1	<1		<1	
1,2,4-TRICHLOROBENZENE (ppb)	<1	<1	<1	<1	<1	<10	<1	
1,2,4-TRIMETHYLBENZENE (ppb)	<1	<1	<1	<1	<1		<1	
1,2-DIBROMO-3-CHLOROPROPANE (ppb)	<1	<1	<1	<1	<1		<1	

* DIS - Dissolved

* TOT - Total

All quantities in mg/L unless otherwise noted
Blank line indicates parameter not tested.

Table 2.3 - SUMMARY OF HELENA LANDFILL AREA WATER QUALITY

Client: CHL01 - City of Helena

Project: Helna Landfill Mtnng

Sample Type: Other Sites

SITE CODE	W-5	W-6	W-6	W-82-2	W-82-4	W-82-4	W-83-7	W-6C1
SAMPLE DATE	05/06/90	05/06/90	05/06/90	11/11/89	11/11/89	05/11/90	11/11/89	04/03/90
LAB	EL	EL	EL	EL	EL	EL	EL	EL
LAB NUMBER	90-10829	90-10830	90-10830	89-20181	89-20180	90-12199	89-20183	7837
REMARKS		DUPLICATE						
SAMPLE NUMBER	HYD-5741	HYD-5774	HYD-5775	HYD-5754	HYD-5743	HYD-5744	HYD-5771	HYD-5780
--- SEMI-VOLATILE EXTRACTABLES ---								
1,2-DICHLOROBENZENE (ppb)	<1	<1	<1	<1	<1	<10	<1	
1,3,5-TRIMETHYLBENZENE (ppb)	<1	<1	<1	<1	<1	<10	<1	
1,3-DICHLOROBENZENE (ppb)	<1	<1	<1	<1	<1	<10	<1	
1,3-DICHLOROPROPANE (ppb)	<1	<1	<1	<1	<1	<10	<1	
1,4-DICHLOROBENZENE (ppb)	<0.5	<0.5	<0.5	<0.5	<0.5	<10	<0.5	
2-METHYL-4,6-DINITROPHENO (ppb)						<50		
2,4,6-TRICHLOROPHENOL (ppb)						<10		
2,4-DICHLOROPHENOL (ppb)						<10		
2,4-DIMETHYLPHENOL (ppb)						<10		
2,4-DINITROPHENOL (ppb)						<50		
2,4-DINITROTOLUENE (ppb)						<10		
2,6-DINITROTOLUENE (ppb)						<10		
2-CHLORONAPHTHALENE (ppb)						<10		
2-CHLOROPHENOL (ppb)						<10		
2-NITROPHENOL (ppb)						<10		
3,3-DICHLOROBENZIDINE (ppb)						<10		
4-BROMOPHENYL PHENYL ETHER (ppb)						<10		
4-CHLORO-3-METHYLPHENOL (ppb)						<10		
4-CHLOROPHENYL PHENYL ETHER (ppb)						<10		
4-NITROPHENOL (ppb)						<50		
ACENAPHTHENE (ppb)						<10		
ACENAPHTHYLENE (ppb)						<10		
ANTHRACENE (ppb)						<10		
AZOBEZENE (1,2-DIPHENYLHYDRAZIN						<10		
BENZIDINE (ppb)						<10		
BENZO (A) ANTHRACENE (ppb)						<10		
BENZO (A) PYRENE (ppb)						<10		
BENZO (B) FLUORANTHENE (ppb)						<10		
BENZO (GHI) PERYLENE (ppb)						<10		
BENZO (K) FLUORANTHENE (ppb)						<10		
BIS (2-CHLOROETHOXY) METHANE (pp						<10		
BIS (2-CHLOROETHYL) ETHER (ppb)						<10		
BIS (2-CHLOROISOPROPYL) ETHER (p						<10		
BIS (2-ETHYLHEXYL) PHTHALATE (pp						<10		
BUTYL BENZYL PHTHALATE (ppb)						<10		
CHRYSENE (ppb)						<10		
DI-N-BUTYLPHTHALATE (ppb)						<10		

* DIS - Dissolved

* TOT - Total

All quantities in mg/L unless otherwise noted

Blank line indicates parameter not tested.

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Table 2.3 - SUMMARY OF HELENA LANDFILL AREA WATER QUALITY

Client: CHL01 - City of Helena
Project: Hlna Landfill Mtrng

Sample Type: Other Sites

SITE CODE	W-5	W-6	W-6	W-82-2	W-82-4	W-82-4	W-83-7	W-GC1
SAMPLE DATE	05/06/90	05/06/90	05/06/90	11/11/89	11/11/89	05/11/90	11/11/89	04/03/90
LAB	EL	EL	EL	EL	EL	EL	EL	EL
LAB NUMBER	90-10829	90-10830	90-10830	89-20181	89-20180	90-12199	89-20183	7837
REMARKS								
SAMPLE NUMBER	HYD-5741	HYD-5774	HYD-5775	HYD-5754	HYD-5743	HYD-5744	HYD-5771	HYD-5780
-- SEMI-VOLATILE EXTRACTABLES --								
DI-N-OCTYL PHTHALATE (ppb)						<10		
DIBENZO (A,H) ANTHRACENE (ppb)						<10		
DIETHYLPHTHALATE (ppb)						<10		
DIMETHYLPHTHALATE (ppb)						<10		
FLUORANTHENE (ppb)						<10		
FLUORENE (ppb)						<10		
HEXACHLOROBENZENE (ppb)						<10		
HEXACHLOROBUTADIENE (ppb)						<10		
HEXACHLORETHANE (ppb)						<10		
INDENO (1,2,3-CD) PYRENE (ppb)						<10		
ISOPHORONE (ppb)						<10		
ISOPROPYLBENZENE (ppb)	<1	<1	<1	<1	<1		<1	
N-BUTYLBENZENE (ppb)	<1	<1	<1	<1	<1		<1	
N-NITROSO-DI-N-PROPYLAMINE (ppb)						<10		
N-NITROSO-PHENYLAMINE (ppb)						<10		
N-PROPYLBENZENE (ppb)	<1	<1	<1	<1	<1		<1	
NAPHTHALENE (ppb)	<1	<1	<1	<1	<1		<1	
NITROBENZENE (ppb)						<10		
P-ISOPROPYLTOLUENE (ppb)	<1	<1	<1	<1	<1		<1	
PENTACHLOROPHENOL (ppb)						<50		
PHENANTHRENE (ppb)						<10		
PHENOL (ppb)						<10		
PYRENE (ppb)						<10		
SEC-BUTYLBENZENE (ppb)	<1	<1	<1	<1	<1		<1	
TERT-BUTYLBENZENE (ppb)	<1	<1	<1	<1	<1		<1	

* DIS - Dissolved

* TOT - Total

All quantities in mg/L unless otherwise noted

Blank line indicates parameter not tested.



APPENDIX B.

STORM DRAIN OUTFALL FLOW MEASUREMENTS

HYDROMETRICS

HELENA, MT

FLOW DISCHARGE CALCULATION

Project: City of Helena Landfill
Station: hlsr-2
Date Measured: 05-16-91

STATION	DIST. (ft)	WIDTH (ft)	DEPTH (ft)	VEL. (ft/sec)	AREA (ft^2)	DISCHARGE (cfs)
E.O.W.	0.30	0.15	0	0	0.04	0
1	0.60	0.25	0.15	0.28	0.04	0.01
2	0.80	0.20	0.20	0.25	0.04	0.00
3	1.00	0.20	0.20	0.30	0.04	0.01
4	1.20	0.20	0.30	0.30	0.06	0.02
5	1.40	0.20	0.30	0.38	0.06	0.02
6	1.60	0.20	0.25	0.43	0.05	0.02
7	1.80	0.20	0.20	0.32	0.04	0.01
8	2.00	0.20	0.15	0.22	0.03	0.00
9	2.20	0.15	0.05	0.17	0.00	0.00
E.O.W.	2.30	0.05	0	0	0.00	0

Flow = 0.12

Flow Method: Pygmy Current Meter
Calc. Method: Rectangular Area Method
Gage Height: ft. Water Temp. (C): Air Temp. (C):
Weather: Partly Cloudy Measured by: WGP
Measurement Conditions: FAIR (8 %)
Calculated Flow: 0.12 + 0.00cfs
Process program and date: HCM-05 (05-17-1991)

25' downstream from tunnel

FLOW DISCHARGE CALCULATION

Project: City of Helena Landfill

Station: HLSR-1

Date Measured: 05-16-91

STATION	DIST. (ft)	WIDTH (ft)	DEPTH (ft)	VEL. (ft/sec)	AREA (ft^2)	DISCHARGE (cfs)
E.O.W.	2.00	0.15	0	0		0
1	2.30	0.30	0.15	0.00	0.04	0.00
2	2.60	0.30	0.30	0.30	0.09	0.03
3	2.90	0.30	0.40	0.28	0.12	0.03
4	3.20	0.30	0.55	0.17	0.16	0.03
5	3.50	0.30	0.60	0.22	0.18	0.04
6	3.80	0.30	0.60	0.17	0.18	0.03
7	4.10	0.30	0.60	0.08	0.18	0.01
8	4.40	0.30	0.55	0.05	0.16	0.00
9	4.70	0.30	0.45	0.00	0.13	0.00
10	5.00	0.30	0.30	0.00	0.09	0.00
E.O.W.	5.30	0.15	0	0		0

Flow = 0.18

Flow Method: Pygmy Current Meter

Calc. Method: Rectangular Area Method

Gage Height: ft. Water Temp. (C): Air Temp. (C):

Weather: Partly Cloudy Measured by: wgp

Measurement Conditions: FAIR (8 %)

Calculated Flow: 0.18 + 0.01cfs

Process program and date: HCM-05 (05-17-1991)

65' Inside tunnel

FLOW DISCHARGE CALCULATION

Project: City of New York
 Date: 11-15-01
 Sheet: 11-15-01

Station	Dist. (ft)	Width (ft)	Depth (ft)	Vel. (ft/sec)	Area (sq ft)	Discharge (cfs)
1.0	0.00	0.00	0.00	0.00	0.00	0.00
2.0	0.00	0.00	0.00	0.00	0.00	0.00
3.0	0.00	0.00	0.00	0.00	0.00	0.00
4.0	0.00	0.00	0.00	0.00	0.00	0.00
5.0	0.00	0.00	0.00	0.00	0.00	0.00
6.0	0.00	0.00	0.00	0.00	0.00	0.00
7.0	0.00	0.00	0.00	0.00	0.00	0.00
8.0	0.00	0.00	0.00	0.00	0.00	0.00
9.0	0.00	0.00	0.00	0.00	0.00	0.00
10.0	0.00	0.00	0.00	0.00	0.00	0.00
11.0	0.00	0.00	0.00	0.00	0.00	0.00
12.0	0.00	0.00	0.00	0.00	0.00	0.00
13.0	0.00	0.00	0.00	0.00	0.00	0.00
14.0	0.00	0.00	0.00	0.00	0.00	0.00
15.0	0.00	0.00	0.00	0.00	0.00	0.00
16.0	0.00	0.00	0.00	0.00	0.00	0.00
17.0	0.00	0.00	0.00	0.00	0.00	0.00
18.0	0.00	0.00	0.00	0.00	0.00	0.00
19.0	0.00	0.00	0.00	0.00	0.00	0.00
20.0	0.00	0.00	0.00	0.00	0.00	0.00
21.0	0.00	0.00	0.00	0.00	0.00	0.00
22.0	0.00	0.00	0.00	0.00	0.00	0.00
23.0	0.00	0.00	0.00	0.00	0.00	0.00
24.0	0.00	0.00	0.00	0.00	0.00	0.00
25.0	0.00	0.00	0.00	0.00	0.00	0.00
26.0	0.00	0.00	0.00	0.00	0.00	0.00
27.0	0.00	0.00	0.00	0.00	0.00	0.00
28.0	0.00	0.00	0.00	0.00	0.00	0.00
29.0	0.00	0.00	0.00	0.00	0.00	0.00
30.0	0.00	0.00	0.00	0.00	0.00	0.00
31.0	0.00	0.00	0.00	0.00	0.00	0.00
32.0	0.00	0.00	0.00	0.00	0.00	0.00
33.0	0.00	0.00	0.00	0.00	0.00	0.00
34.0	0.00	0.00	0.00	0.00	0.00	0.00
35.0	0.00	0.00	0.00	0.00	0.00	0.00
36.0	0.00	0.00	0.00	0.00	0.00	0.00
37.0	0.00	0.00	0.00	0.00	0.00	0.00
38.0	0.00	0.00	0.00	0.00	0.00	0.00
39.0	0.00	0.00	0.00	0.00	0.00	0.00
40.0	0.00	0.00	0.00	0.00	0.00	0.00
41.0	0.00	0.00	0.00	0.00	0.00	0.00
42.0	0.00	0.00	0.00	0.00	0.00	0.00
43.0	0.00	0.00	0.00	0.00	0.00	0.00
44.0	0.00	0.00	0.00	0.00	0.00	0.00
45.0	0.00	0.00	0.00	0.00	0.00	0.00
46.0	0.00	0.00	0.00	0.00	0.00	0.00
47.0	0.00	0.00	0.00	0.00	0.00	0.00
48.0	0.00	0.00	0.00	0.00	0.00	0.00
49.0	0.00	0.00	0.00	0.00	0.00	0.00
50.0	0.00	0.00	0.00	0.00	0.00	0.00

Flow = 0.00

Flow Method: Velocity Area Method
 Data Source: Field Measurements
 Data Points: 50
 Data Range: 0.00 to 0.00
 Data Units: cfs
 Data Date: 11-15-01
 Data Time: 11:00 AM
 Data Location: New York City
 Data Project: City of New York
 Data Sheet: 11-15-01
 Data File: 11-15-01

Flow = 0.00

HYDROMETRICS

Belton, W.

STREAM GAGING - PIGMY METER (0.8 DEPTH)

PROJECT:

Soft-Landfill

DATE _____

SITE.

HLR-2

FLOW

[illegible]

PARTY

COMP. BY

CXED. BY

WEATHER

AIR TEMP.

WATER TEMP.

SIDEWALL & BOTTOM COND.

MEAS. COND. & RATING GOOD (5%), FAIR (8%), POOR (12%), VERY POOR (20%).

OTHER (EXPLAIN)

REMARKS

CAGE HEIGHT

143' OUTSIDE TURNS



Wolcott, W.

STREAM GAGING - RIGBY METER (0.8 DEPTH)

PROJECT

COH - 12/11/11

DATE

5-16-91

SITE.

HSR-4

FLOW

[illegible]

PARTY: _____ COMP. BY _____ CKED. BY _____

WEATHER _____ AIR TEMP. _____ WATER TEMP. _____

STREAM & BOTTOM COND. _____

WEAS. COND. & RATING GOOD (5%), FAIR (8%), POOR (12%), VERY POOR (20%).

OTHER (EXPLAIN) _____

CAGE HEIGHT _____ REMARKS _____

300' outside Tunnel

APPENDIX C.

WATER QUALITY DATA

WATER QUALITY DATA

WATER QUALITY DATA

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Steve Downs
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-10827
DATE: 05/23/90 dya

WATER ANALYSIS

Helena Landfill

HL-9005-110

Sampled 05/06/90 @ 1125

Submitted 05/08/90

1

<u>Volatile Organic Constituent</u>	<u>µg/l</u>
Dichlorodifluoromethane	<1.0*
Chloromethane	<1.0
Vinyl chloride	<0.50
Bromomethane	<1.0
Chloroethane	<1.0
Trichlorofluoromethane	<1.0
1,1-Dichloroethene	<0.50
Methylene Chloride	<1.0
trans-1,2-Dichloroethene	<1.0
1,1-Dichloroethane	<1.0
2,2-Dichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0
Chloroform	7.9
Bromochloromethane	<1.0
1,1,1-Trichloroethane	<0.50
Carbon Tetrachloride	<0.50
1,1-Dichloropropene	<1.0
Benzene	<0.50
1,2-Dichloroethane	<0.50
Trichloroethene	<0.50
1,2-Dichloropropane	<1.0
Bromodichloromethane	<1.0*
Dibromomethane	<1.0
Toluene	<1.0
1,1,2-Trichloroethane	<1.0
Tetrachloroethene	0.83
1,3-Dichloropropane	<1.0
Dibromochloromethane	<1.0
1,2-Dibromoethane	<1.0
Chlorobenzene	<1.0

<u>Volatile Organic Constituent</u>	<u>µg/l</u>
1,1,1,2-Tetrachloroethane	<1.0
Ethylbenzene	<1.0
p-Xylene	<1.0
m-Xylene	<1.0
o-Xylene	<1.0
Styrene	<1.0
Bromoform	<1.0
Isopropylbenzene	<1.0
1,1,2,2-Tetrachloroethane	<1.0
Bromobenzene	<1.0
1,2,3-Trichloropropane	<1.0
n-Propylbenzene	<1.0
2-Chlorotoluene	<1.0
1,3,5-Trimethylbenzene	<1.0
4-Chlorotoluene	<1.0
tert-Butylbenzene	<1.0
1,2,4-Trimethylbenzene	<1.0
sec-Butylbenzene	<1.0
p-Isopropyltoluene	<1.0
1,3-Dichlorobenzene	<1.0
1,4-Dichlorobenzene	<0.50
n-Butylbenzene	<1.0
1,2-Dichlorobenzene	<1.0
1,2-Dibromo-3-Chloropropane	<1.0
1,2,4-Trichlorobenzene	<1.0
Hexachlorobutadiene	<1.0
Naphthalene	<1.0
1,2,3-Trichlorobenzene	<1.0
cis-1,3-Dichloropropene	<1.0
trans-1,3-Dichloropropene	<1.0
Dichloromonofluoromethane	<1.0*

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA Method 502.2

*Present but less than the practical quantitation limit.

COMPLETE ENVIRONMENTAL ANALYTICAL SERVICE

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Steve Downs
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-10829
DATE: 05/23/90 dya

WATER ANALYSIS

Helena Landfill

HL-9005-112

Sampled 05/06/90 @ 1145

Submitted 05/08/90

#5

Volatile Organic Constituent

	<u>µg/l</u>
Dichlorodifluoromethane	1.0
Chloromethane	<1.0
Vinyl chloride	<0.50
Bromomethane	<1.0
Chloroethane	<1.0
Trichlorofluoromethane	<1.0
1,1-Dichloroethene	<0.50
Methylene Chloride	<1.0
trans-1,2-Dichloroethene	<1.0
1,1-Dichloroethane	<1.0
2,2-Dichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0
Chloroform	2.3
Bromochloromethane	<1.0
1,1,1-Trichloroethane	<0.50
Carbon Tetrachloride	<0.50
1,1-Dichloropropene	<1.0
Benzene	<0.50
1,2-Dichloroethane	<0.50
Trichloroethene	<0.50
1,2-Dichloropropane	<1.0
Bromodichloromethane	<1.0
Dibromomethane	<1.0
Toluene	<1.0
1,1,2-Trichloroethane	<1.0
Tetrachloroethene	<0.50*
1,3-Dichloropropane	<1.0
Dibromochloromethane	<1.0
1,2-Dibromoethane	<1.0
Chlorobenzene	<1.0

Volatile Organic Constituent

	<u>µg/l</u>
1,1,1,2-Tetrachloroethane	<1.0
Ethylbenzene	<1.0
p-Xylene	<1.0
m-Xylene	<1.0
o-Xylene	<1.0
Styrene	<1.0
Bromoform	<1.0
Isopropylbenzene	<1.0
1,1,2,2-Tetrachloroethane	<1.0
Bromobenzene	<1.0
1,2,3-Trichloropropane	<1.0
n-Propylbenzene	<1.0
2-Chlorotoluene	<1.0
1,3,5-Trimethylbenzene	<1.0
4-Chlorotoluene	<1.0
tert-Butylbenzene	<1.0
1,2,4-Trimethylbenzene	<1.0
sec-Butylbenzene	<1.0
p-Isopropyltoluene	<1.0
1,3-Dichlorobenzene	<1.0
1,4-Dichlorobenzene	<0.50
n-Butylbenzene	<1.0
1,2-Dichlorobenzene	<1.0
1,2-Dibromo-3-Chloropropane	<1.0
1,2,4-Trichlorobenzene	<1.0
Hexachlorobutadiene	<1.0
Naphthalene	<1.0
1,2,3-Trichlorobenzene	<1.0
cis-1,3-Dichloropropene	<1.0
trans-1,3-Dichloropropene	<1.0
Dichloromonofluoromethane	<1.0*

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA Method 502.2

*Present but less than the practical quantitation limit.

COMPLETE ENVIRONMENTAL ANALYTICAL SERVICE

ENERGY LABORATORIES

ENERGY LABORATORIES, INC.

P.O. BOX 30916 • 1107 SOUTH BROADWAY • BILLINGS, MT 59107-0916 • PHONE (406) 252-6325
FAX (406) 252-6069 • 1-800-873-5227

LABORATORY REPORT

PAGE : 1

To : Hydrometrics
Address : Attn: Steve Downs
2727 Airport Road
Helena, MT 59061

Lab No. : 91-13087
Date : 6/14/91

WATER ANALYSIS REPORT

Sample Pt Name : HL9104-110
Sample Date : 4/13/91
Sample Time : 13:00:00
Sample Received : 4/16/91
Helena Landfill
Revised 06/14/91

LABORATORY DATA:

Acetone-----	(ug/l)----	<10
Acrolein-----	(ug/l)----	<10
Acrylonitrile-----	(ug/l)----	<10
Benzene-----	(ug/l)----	<0.50
Bromochloromethane-----	(ug/l)----	<1.0
Bromodichloromethane-----	(ug/l)----	<1.0
trans-1,3-Dichloropropene-----	(ug/l)----	<1.0
cis-1,3-Dichloropropene-----	(ug/l)----	<1.0
1,4-Difluorobenzene-----	(ug/l)----	<10
Ethanol-----	(mg/l)----	<10
Ethylbenzene-----	(ug/l)----	<1.0
Ethyl methacrylate-----	(ug/l)----	<10
4-Bromofluorobenzene-----	(ug/l)----	<10
Bromoform-----	(ug/l)----	<1.0
Bromomethane-----	(ug/l)----	<1.0
2-Butanone(Methyl Ethyl Ketone)-----	(ug/l)----	<10
Carbon disulfide-----	(ug/l)----	<10
Carbon Tetrachloride-----	(ug/l)----	<0.50
Chlorobenzene-----	(ug/l)----	<1.0
Dibromochloromethane-----	(ug/l)----	<1.0
Chloroethane-----	(ug/l)----	<1.0
2-Chloroethylvinyl ether-----	(ug/l)----	<10
Chloroform-----	(ug/l)----	2.3
Chloromethane-----	(ug/l)----	<1.0
Dibromomethane-----	(ug/l)----	<1.0
1,4-Dichloro-2-butene-----	(ug/l)----	<10
Dichlorodifluoromethane-----	(ug/l)----	<1.0
1,1-Dichloroethane-----	(ug/l)----	<1.0
1,2-Dichloroethane-----	(ug/l)----	<0.50
2-Hexanone-----	(ug/l)----	<10
Iodomethane-----	(ug/l)----	<10
Methylene Chloride-----	(ug/l)----	<1.0
Methyl-2-pentanone-----	(ug/l)----	<10
trans-1,2-Dichloroethene-----	(ug/l)----	<0.50
Styrene-----	(ug/l)----	<1.0

LABORATORY REPORT

PAGE : 2

To : Hydrometrics
Address : Attn: Steve Downs
2727 Airport Road
Helena, MT 59061

Lab No. : 91-13087
Date : 6/14/91

WATER ANALYSIS REPORT

Sample Pt Name : HL9104-110
Sample Date : 4/13/91
Sample Time : 13:00:00
Sample Received : 4/16/91
Helena Landfill
Revised 06/14/91

LABORATORY DATA:

1,1,2,2-Tetrachloroethane-----	(ug/l)----	<1.0
Tetrachloroethene-----	(ug/l)----	0.50
Toluene-----	(ug/l)----	<1.0
1,1,1-Trichloroethane-----	(ug/l)----	<0.50
1,1,2-Trichloroethane-----	(ug/l)----	<1.0
Trichloroethene-----	(ug/l)----	<0.50
Chlorofluoromethane-----	(ug/l)----	<1.0
1,3-Trichloropropane-----	(ug/l)----	<1.0
Vinyl acetate-----	(ug/l)----	<0.50
Vinyl chloride-----	(ug/l)----	<1.0
Xylenes-----	(ug/l)----	

cc:

LABORATORY REPORTTO: Hydrometrics
ADDRESS: Steve Downs
2727 Airport Road
Helena, MT 59601LAB NO.: 90-10830
DATE: 05/23/90 dyaWATER ANALYSIS

Helena Landfill

HL-9005-113

Sampled 05/06/90 @ 1200

Submitted 05/08/90

6

<u>Volatile Organic Constituent</u>	<u>µg/l</u>	<u>Volatile Organic Constituent</u>	<u>µg/l</u>
Dichlorodifluoromethane	<1.0	1,1,1,2-Tetrachloroethane	<1.0
Chloromethane	<1.0	Ethylbenzene	<1.0
Vinyl chloride	<0.50	p-Xylene	<1.0
Bromomethane	<1.0	m-Xylene	<1.0
Chloroethane	<1.0	o-Xylene	<1.0
Trichlorofluoromethane	<1.0	Styrene	<1.0
1,1-Dichloroethene	<0.50	Bromoform	<1.0
Methylene Chloride	<1.0	Isopropylbenzene	<1.0
trans-1,2-Dichloroethene	<1.0	1,1,2,2-Tetrachloroethane	<1.0
1,1-Dichloroethane	<1.0	Bromobenzene	<1.0
2,2-Dichloropropane	<1.0	1,2,3-Trichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0	n-Propylbenzene	<1.0
Chloroform	2.0	2-Chlorotoluene	<1.0
Bromochloromethane	<1.0	1,3,5-Trimethylbenzene	<1.0
1,1,1-Trichloroethane	<0.50	4-Chlorotoluene	<1.0
Carbon Tetrachloride	<0.50	tert-Butylbenzene	<1.0
1,1-Dichloropropene	<1.0	1,2,4-Trimethylbenzene	<1.0
Benzene	<0.50	sec-Butylbenzene	<1.0
1,2-Dichloroethane	<0.50	p-Isopropyltoluene	<1.0
Trichloroethene	<0.50	1,3-Dichlorobenzene	<1.0
1,2-Dichloropropane	<1.0	1,4-Dichlorobenzene	<0.50
Bromodichloromethane	<1.0	n-Butylbenzene	<1.0
Dibromomethane	<1.0	1,2-Dichlorobenzene	<1.0
Toluene	<1.0	1,2-Dibromo-3-Chloropropane	<1.0
1,1,2-Trichloroethane	<1.0	1,2,4-Trichlorobenzene	<1.0
Tetrachloroethene	<0.50	Hexachlorobutadiene	<1.0
1,3-Dichloropropane	<1.0	Naphthalene	<1.0
Dibromochloromethane	<1.0	1,2,3-Trichlorobenzene	<1.0
1,2-Dibromoethane	<1.0	cis-1,3-Dichloropropene	<1.0
Chlorobenzene	<1.0	trans-1,3-Dichloropropene	<1.0
		Dichloromonofluoromethane	<1.0

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA Method 502.2

*Present but less than the practical quantitation limit.

COMPLETE ENVIRONMENTAL ANALYTICAL SERVICE

LABORATORY REPORT

LAB NO: 10-1000
DATE: 06/23/90

TO:
ADDRESS:
237 Airport Road
Helena, MT 59601

WATER ANALYSIS
Helena Landfill
HL-9005-113
Sampled 05/05/90 @ 1200
Submitted 06/23/90

6

Variable Organic Compounds	mg/L	Variable Organic Compounds	mg/L
1,1,2-Trichloroethane	<1.0	1,1,2-Trichloroethane	<1.0
Ethylbenzene	<1.0	Ethylbenzene	<1.0
p-Xylene	<0.50	p-Xylene	<0.50
m-Xylene	<1.0	m-Xylene	<1.0
o-Xylene	<1.0	o-Xylene	<1.0
Styrene	<1.0	Styrene	<1.0
Bromobenzene	<1.0	Bromobenzene	<1.0
Isopropylbenzene	<1.0	Isopropylbenzene	<1.0
1,1,2,2-Tetrachloroethane	<1.0	1,1,2,2-Tetrachloroethane	<1.0
Bromobenzene	<1.0	Bromobenzene	<1.0
1,2,3-Trichloropropane	<1.0	1,2,3-Trichloropropane	<1.0
n-Propylbenzene	<1.0	n-Propylbenzene	<1.0
2-Chlorotoluene	<1.0	2-Chlorotoluene	<1.0
1,3,5-Trimethylbenzene	<1.0	1,3,5-Trimethylbenzene	<1.0
4-Chlorotoluene	<1.0	4-Chlorotoluene	<1.0
1,2,4-Trimethylbenzene	<1.0	1,2,4-Trimethylbenzene	<1.0
1,2,4-Trimethylbenzene	<1.0	1,2,4-Trimethylbenzene	<1.0
sec-Butylbenzene	<1.0	sec-Butylbenzene	<1.0
Isopropylbenzene	<1.0	Isopropylbenzene	<1.0
1,2-Dichlorobenzene	<1.0	1,2-Dichlorobenzene	<1.0
1,4-Dichlorobenzene	<0.50	1,4-Dichlorobenzene	<0.50
n-Butylbenzene	<1.0	n-Butylbenzene	<1.0
1,3-Dichlorobenzene	<1.0	1,3-Dichlorobenzene	<1.0
1,2-Dichloro-3-Chloropropane	<1.0	1,2-Dichloro-3-Chloropropane	<1.0
1,2,4-Trichlorobenzene	<1.0	1,2,4-Trichlorobenzene	<1.0
Hexachlorocyclopentadiene	<1.0	Hexachlorocyclopentadiene	<1.0
Isopentane	<1.0	Isopentane	<1.0
1,2,3-Trichlorobenzene	<1.0	1,2,3-Trichlorobenzene	<1.0
cis-1,2-Dichloropropane	<1.0	cis-1,2-Dichloropropane	<1.0
trans-1,2-Dichloropropane	<1.0	trans-1,2-Dichloropropane	<1.0
Dichloromethylfluoromethane	<1.0	Dichloromethylfluoromethane	<1.0

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed
accordance with EPA Method 821.0
*Present but less than the practical quantitation limit.
EPA/ASTM ENVIRONMENTAL ANALYTICAL SERVICE

LABORATORY REPORTTO: Hydrometrics
ADDRESS: Steve Downs
2727 Airport Road
Helena, MT 59601LAB NO.: 90-10830 dup
DATE: 05/23/90 dyaQUALITY ASSURANCE - DUPLICATE ANALYSIS

Helena Landfill

HL-9005-113

Sampled 05/06/90 @ 1200

Submitted 05/08/90

Dup # 6

<u>Volatile Organic Constituent</u>	<u>µg/l</u>
Dichlorodifluoromethane	<1.0
Chloromethane	<1.0
Vinyl chloride	<0.50
Bromomethane	<1.0
Chloroethane	<1.0
Trichlorofluoromethane	<1.0
1,1-Dichloroethene	<0.50
Methylene Chloride	<1.0
trans-1,2-Dichloroethene	<1.0
1,1-Dichloroethane	<1.0
2,2-Dichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0
Chloroform	2.0
Bromochloromethane	<1.0
1,1,1-Trichloroethane	<0.50
Carbon Tetrachloride	<0.50
1,1-Dichloropropene	<1.0
Benzene	<0.50
1,2-Dichloroethane	<0.50
Trichloroethene	<1.0
1,2-Dichloropropane	<1.0
Bromodichloromethane	<1.0
Dibromomethane	<1.0
Toluene	<1.0
1,1,2-Trichloroethane	<1.0
Tetrachloroethene	<0.50
1,3-Dichloropropane	<1.0
Dibromochloromethane	<1.0
1,2-Dibromoethane	<1.0
Chlorobenzene	<1.0

<u>Volatile Organic Constituent</u>	<u>µg/l</u>
1,1,1,2-Tetrachloroethane	<1.0
Ethylbenzene	<1.0
p-Xylene	<1.0
m-Xylene	<1.0
o-Xylene	<1.0
Styrene	<1.0
Bromoform	<1.0
Isopropylbenzene	<1.0
1,1,2,2-Tetrachloroethane	<1.0
Bromobenzene	<1.0
1,2,3-Trichloropropane	<1.0
n-Propylbenzene	<1.0
2-Chlorotoluene	<1.0
1,3,5-Trimethylbenzene	<1.0
4-Chlorotoluene	<1.0
tert-Butylbenzene	<1.0
1,2,4-Trimethylbenzene	<1.0
sec-Butylbenzene	<1.0
p-Isopropyltoluene	<1.0
1,3-Dichlorobenzene	<1.0
1,4-Dichlorobenzene	<0.50
n-Butylbenzene	<1.0
1,2-Dichlorobenzene	<1.0
1,2-Dibromo-3-Chloropropane	<1.0
1,2,4-Trichlorobenzene	<1.0
Hexachlorobutadiene	<1.0
Naphthalene	<1.0
1,2,3-Trichlorobenzene	<1.0
cis-1,3-Dichloropropene	<1.0
trans-1,3-Dichloropropene	<1.0
Dichloromonofluoromethane	<1.0

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed
accordance with EPA Method 502.2.

*Present but less than the practical quantitation limit.

COMPLETE ENVIRONMENTAL ANALYTICAL SERVICE

LABORATORY REPORT

LAS NO: 80-0000-000
DATE: 02/28/00

TO: [REDACTED]
ADDRESS: [REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]

QUALITY ASSURANCE - ANALYST ANALYSIS

Sampled on 02/28/00 at 12:00
Sampled by [REDACTED]
[REDACTED]

Page 2 of 2

Concentration	Concentration	Concentration
1,1-Dichloroethane	1,1-Dichloroethane	1,1-Dichloroethane
1,2-Dichloroethane	1,2-Dichloroethane	1,2-Dichloroethane
1,3-Dichloroethane	1,3-Dichloroethane	1,3-Dichloroethane
1,4-Dichloroethane	1,4-Dichloroethane	1,4-Dichloroethane
1,1,1-Trichloroethane	1,1,1-Trichloroethane	1,1,1-Trichloroethane
1,1,2-Trichloroethane	1,1,2-Trichloroethane	1,1,2-Trichloroethane
1,1,3-Trichloroethane	1,1,3-Trichloroethane	1,1,3-Trichloroethane
1,2,3-Trichloroethane	1,2,3-Trichloroethane	1,2,3-Trichloroethane
1,1,2,2-Tetrachloroethane	1,1,2,2-Tetrachloroethane	1,1,2,2-Tetrachloroethane
1,1,1,2-Tetrachloroethane	1,1,1,2-Tetrachloroethane	1,1,1,2-Tetrachloroethane
1,1,1,3-Tetrachloroethane	1,1,1,3-Tetrachloroethane	1,1,1,3-Tetrachloroethane
1,1,2,3-Tetrachloroethane	1,1,2,3-Tetrachloroethane	1,1,2,3-Tetrachloroethane
1,1,2,4-Tetrachloroethane	1,1,2,4-Tetrachloroethane	1,1,2,4-Tetrachloroethane
1,1,3,3-Tetrachloroethane	1,1,3,3-Tetrachloroethane	1,1,3,3-Tetrachloroethane
1,2,3,4-Tetrachloroethane	1,2,3,4-Tetrachloroethane	1,2,3,4-Tetrachloroethane
1,1,1,1,2-Pentachloroethane	1,1,1,1,2-Pentachloroethane	1,1,1,1,2-Pentachloroethane
1,1,1,1,3-Pentachloroethane	1,1,1,1,3-Pentachloroethane	1,1,1,1,3-Pentachloroethane
1,1,1,2,2-Pentachloroethane	1,1,1,2,2-Pentachloroethane	1,1,1,2,2-Pentachloroethane
1,1,1,2,3-Pentachloroethane	1,1,1,2,3-Pentachloroethane	1,1,1,2,3-Pentachloroethane
1,1,1,3,3-Pentachloroethane	1,1,1,3,3-Pentachloroethane	1,1,1,3,3-Pentachloroethane
1,1,2,2,3-Pentachloroethane	1,1,2,2,3-Pentachloroethane	1,1,2,2,3-Pentachloroethane
1,1,2,3,3-Pentachloroethane	1,1,2,3,3-Pentachloroethane	1,1,2,3,3-Pentachloroethane
1,2,2,3,3-Pentachloroethane	1,2,2,3,3-Pentachloroethane	1,2,2,3,3-Pentachloroethane
1,1,1,1,2,2-Hexachloroethane	1,1,1,1,2,2-Hexachloroethane	1,1,1,1,2,2-Hexachloroethane
1,1,1,1,2,3-Hexachloroethane	1,1,1,1,2,3-Hexachloroethane	1,1,1,1,2,3-Hexachloroethane
1,1,1,1,3,3-Hexachloroethane	1,1,1,1,3,3-Hexachloroethane	1,1,1,1,3,3-Hexachloroethane
1,1,1,2,2,3-Hexachloroethane	1,1,1,2,2,3-Hexachloroethane	1,1,1,2,2,3-Hexachloroethane
1,1,1,2,3,3-Hexachloroethane	1,1,1,2,3,3-Hexachloroethane	1,1,1,2,3,3-Hexachloroethane
1,1,2,2,3,3-Hexachloroethane	1,1,2,2,3,3-Hexachloroethane	1,1,2,2,3,3-Hexachloroethane
1,1,2,3,3,3-Hexachloroethane	1,1,2,3,3,3-Hexachloroethane	1,1,2,3,3,3-Hexachloroethane
1,2,2,3,3,3-Hexachloroethane	1,2,2,3,3,3-Hexachloroethane	1,2,2,3,3,3-Hexachloroethane
1,1,1,1,1,2-Heptachloroethane	1,1,1,1,1,2-Heptachloroethane	1,1,1,1,1,2-Heptachloroethane
1,1,1,1,1,3-Heptachloroethane	1,1,1,1,1,3-Heptachloroethane	1,1,1,1,1,3-Heptachloroethane
1,1,1,1,2,2-Heptachloroethane	1,1,1,1,2,2-Heptachloroethane	1,1,1,1,2,2-Heptachloroethane
1,1,1,1,2,3-Heptachloroethane	1,1,1,1,2,3-Heptachloroethane	1,1,1,1,2,3-Heptachloroethane
1,1,1,1,3,3-Heptachloroethane	1,1,1,1,3,3-Heptachloroethane	1,1,1,1,3,3-Heptachloroethane
1,1,1,2,2,3-Heptachloroethane	1,1,1,2,2,3-Heptachloroethane	1,1,1,2,2,3-Heptachloroethane
1,1,1,2,3,3-Heptachloroethane	1,1,1,2,3,3-Heptachloroethane	1,1,1,2,3,3-Heptachloroethane
1,1,2,2,3,3-Heptachloroethane	1,1,2,2,3,3-Heptachloroethane	1,1,2,2,3,3-Heptachloroethane
1,1,2,3,3,3-Heptachloroethane	1,1,2,3,3,3-Heptachloroethane	1,1,2,3,3,3-Heptachloroethane
1,2,2,3,3,3-Heptachloroethane	1,2,2,3,3,3-Heptachloroethane	1,2,2,3,3,3-Heptachloroethane
1,1,1,1,1,2,2-Octachloroethane	1,1,1,1,1,2,2-Octachloroethane	1,1,1,1,1,2,2-Octachloroethane
1,1,1,1,1,2,3-Octachloroethane	1,1,1,1,1,2,3-Octachloroethane	1,1,1,1,1,2,3-Octachloroethane
1,1,1,1,1,3,3-Octachloroethane	1,1,1,1,1,3,3-Octachloroethane	1,1,1,1,1,3,3-Octachloroethane
1,1,1,1,2,2,3-Octachloroethane	1,1,1,1,2,2,3-Octachloroethane	1,1,1,1,2,2,3-Octachloroethane
1,1,1,1,2,3,3-Octachloroethane	1,1,1,1,2,3,3-Octachloroethane	1,1,1,1,2,3,3-Octachloroethane
1,1,1,2,2,3,3-Octachloroethane	1,1,1,2,2,3,3-Octachloroethane	1,1,1,2,2,3,3-Octachloroethane
1,1,1,2,3,3,3-Octachloroethane	1,1,1,2,3,3,3-Octachloroethane	1,1,1,2,3,3,3-Octachloroethane
1,1,2,2,3,3,3-Octachloroethane	1,1,2,2,3,3,3-Octachloroethane	1,1,2,2,3,3,3-Octachloroethane
1,2,2,3,3,3,3-Octachloroethane	1,2,2,3,3,3,3-Octachloroethane	1,2,2,3,3,3,3-Octachloroethane

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed according to EPA Method 821.

*Present but less than the practical quantitation limit.
COMPLETE ENVIRONMENTAL ANALYTICAL SERVICE

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Randy Huffsmith
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-15042
DATE: 06/18/90 dya

WATER ANALYSIS

Helena City Landfill
HL-9006-104

Sampled 06/06/90 @ 1210

Submitted 06/07/90

9

Volatile Organic Constituent

	<u>µg/l</u>
Dichlorodifluoromethane	<1.0
Chloromethane	<1.0
Vinyl chloride	<0.50
Bromomethane	<1.0
Chloroethane	<1.0
Trichlorofluoromethane	<1.0
1,1-Dichloroethene	<0.50
Methylene Chloride	<1.0
trans-1,2-Dichloroethene	<1.0
1,1-Dichloroethane	<1.0
2,2-Dichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0
Chloroform	<1.0
Bromochloromethane	<1.0
1,1,1-Trichloroethane	<0.50
Carbon Tetrachloride	<0.50
1,1-Dichloropropene	<1.0
Benzene	<0.50
1,2-Dichloroethane	<0.50
Trichloroethene	<0.50
1,2-Dichloropropane	<1.0
Bromodichloromethane	<1.0
Dibromomethane	<1.0
Toluene	<1.0
1,1,2-Trichloroethane	<1.0
Tetrachloroethene	<0.50
1,3-Dichloropropane	<1.0
Dibromochloromethane	<1.0
1,2-Dibromoethane	<1.0
Chlorobenzene	<1.0

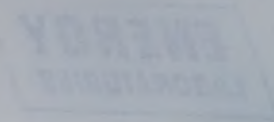
Volatile Organic Constituent

	<u>µg/l</u>
1,1,1,2-Tetrachloroethane	<1.0
Ethylbenzene	<1.0
p-Xylene	<1.0
m-Xylene	<1.0
o-Xylene	<1.0
Styrene	<1.0
Bromoform	<1.0
Isopropylbenzene	<1.0
1,1,2,2-Tetrachloroethane	<1.0
Bromobenzene	<1.0
1,2,3-Trichloropropane	<1.0
n-Propylbenzene	<1.0
2-Chlorotoluene	<1.0
1,3,5-Trimethylbenzene	<1.0
4-Chlorotoluene	<1.0
tert-Butylbenzene	<1.0
1,2,4-Trimethylbenzene	<1.0
sec-Butylbenzene	<1.0
p-Isopropyltoluene	<1.0
1,3-Dichlorobenzene	<1.0
1,4-Dichlorobenzene	<0.50
n-Butylbenzene	<1.0
1,2-Dichlorobenzene	<1.0
1,2-Dibromo-3-Chloropropane	<1.0
1,2,4-Trichlorobenzene	<1.0
Hexachlorobutadiene	<1.0
Naphthalene	<1.0
1,2,3-Trichlorobenzene	<1.0
cis-1,3-Dichloropropene	<1.0
trans-1,3-Dichloropropene	<1.0
Dichloromonofluoromethane	<1.0

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA Method 502.2.

*Present but less than the practical quantitation limit.

COMPLETE ENVIRONMENTAL ANALYTICAL SERVICE



ENERGY LABORATORY, INC.

NO. 202-222-1111 • 100 SOUTH WASHINGTON • SUITE 100 • WASHINGTON, D.C. 20004

LABORATORY REPORT

LAB. NO. 001200
DATE: 08/20/90

TO:
ADDRESS:
222 ALPINE ROAD
MELAND, MT 59001

WATER ANALYSIS
MELAND CITY LANDFILL
HL-0005-104
Samples collected @ 10:00
Submerged Section
p 2

ANALYTE	CONCENTRATION	ANALYTE	CONCENTRATION	ANALYTE	CONCENTRATION
Chlorobenzene	<1.0	1,1,1-Trichloroethane	<1.0	1,1,1-Trichloroethane	<1.0
Chloroethane	<1.0	1,1,2-Trichloroethane	<1.0	1,1,2-Trichloroethane	<1.0
Vinyl Chloride	<0.50	1,2-Dichloroethane	<1.0	1,2-Dichloroethane	<1.0
Bromobenzene	<1.0	1,2,3-Trichloroethane	<1.0	1,2,3-Trichloroethane	<1.0
Bromochloroethane	<1.0	1,2,4-Trichloroethane	<1.0	1,2,4-Trichloroethane	<1.0
1,1-Dichloroethane	<0.50	1,3,5-Trichlorobenzene	<1.0	1,3,5-Trichlorobenzene	<1.0
1,2-Dichloroethane	<1.0	1,3,6-Trichlorobenzene	<1.0	1,3,6-Trichlorobenzene	<1.0
Methylene Chloride	<1.0	1,4-Dichlorobenzene	<0.50	1,4-Dichlorobenzene	<0.50
1,1,1-Trichloroethane	<1.0	1,4,5-Trichlorobenzene	<0.50	1,4,5-Trichlorobenzene	<0.50
1,1,2-Trichloroethane	<1.0	1,2,4,5-Tetrachlorobenzene	<1.0	1,2,4,5-Tetrachlorobenzene	<1.0
1,2-Dichloroethane	<1.0	1,2,3,4-Tetrachlorobenzene	<1.0	1,2,3,4-Tetrachlorobenzene	<1.0
1,2,3-Trichloroethane	<1.0	1,2,3,5-Tetrachlorobenzene	<1.0	1,2,3,5-Tetrachlorobenzene	<1.0
1,2,4-Trichloroethane	<1.0	1,2,3,6-Tetrachlorobenzene	<1.0	1,2,3,6-Tetrachlorobenzene	<1.0
1,3,5-Trichlorobenzene	<1.0	1,3,4,5-Tetrachlorobenzene	<1.0	1,3,4,5-Tetrachlorobenzene	<1.0
1,3,6-Trichlorobenzene	<1.0	1,2,3,4,5-Pentachlorobenzene	<1.0	1,2,3,4,5-Pentachlorobenzene	<1.0
1,4-Dichlorobenzene	<0.50	1,2,3,4,6-Pentachlorobenzene	<1.0	1,2,3,4,6-Pentachlorobenzene	<1.0
1,4,5-Trichlorobenzene	<0.50	1,2,3,5,6-Pentachlorobenzene	<1.0	1,2,3,5,6-Pentachlorobenzene	<1.0
1,2,4,5-Tetrachlorobenzene	<1.0	1,2,3,4,5,6-Hexachlorobenzene	<1.0	1,2,3,4,5,6-Hexachlorobenzene	<1.0
1,2,3,4-Tetrachlorobenzene	<1.0				
1,2,3,5-Tetrachlorobenzene	<1.0				
1,2,3,6-Tetrachlorobenzene	<1.0				
1,2,4,6-Tetrachlorobenzene	<1.0				
1,3,4,5-Tetrachlorobenzene	<1.0				
1,3,4,6-Tetrachlorobenzene	<1.0				
1,3,5,6-Tetrachlorobenzene	<1.0				
1,4,5,6-Tetrachlorobenzene	<1.0				
1,2,3,4,5-Pentachlorobenzene	<1.0				
1,2,3,4,6-Pentachlorobenzene	<1.0				
1,2,3,5,6-Pentachlorobenzene	<1.0				
1,2,3,4,5,6-Hexachlorobenzene	<1.0				

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed according with EPA Method 802.2.
*Present but less than the practical quantitation limit
CONCENTRATION ENVIRONMENTAL ANALYTICAL SERVICE

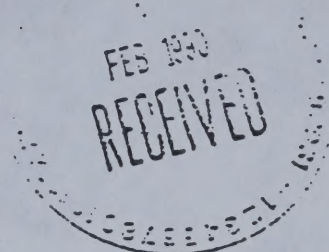
LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Bill Peery
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-3298
DATE: 02/20/90 dya

WATER ANALYSIS

City of Helena
HL90-10
Sampled 02/16/90 @ 9:30
Submitted 02/19/90



#13

<u>Volatile Organic Constituent</u>	<u>µg/l</u>	<u>Volatile Organic Constituent</u>	<u>µg/l</u>
Dichlorodifluoromethane	4.3	1,1,1,2-Tetrachloroethane	<1.0
Chloromethane	<1.0	Ethylbenzene	<1.0
Vinyl chloride	<0.50	p-Xylene	<1.0
Bromomethane	<1.0	m-Xylene	<1.0
Chloroethane	<1.0	o-Xylene	<1.0
Trichlorofluoromethane	<1.0	Styrene	<1.0
1,1-Dichloroethene	<0.50	Bromoform	<1.0
Methylene Chloride	<1.0*	Isopropylbenzene	<1.0
trans-1,2-Dichloroethene	<1.0	1,1,2,2-Tetrachloroethane	<1.0
1,1-Dichloroethane	<1.0*	Bromobenzene	<1.0
2,2-Dichloropropane	<1.0	1,2,3-Trichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0*	n-Propylbenzene	<1.0
Chloroform	2.9	2-Chlorotoluene	<1.0
Bromochloromethane	<1.0	1,3,5-Trimethylbenzene	<1.0
1,1,1-Trichloroethane	0.78	4-Chlorotoluene	<1.0
Carbon Tetrachloride	<0.50	tert-Butylbenzene	<1.0
1,1-Dichloropropene	<1.0	1,2,4-Trimethylbenzene	<1.0
Benzene	<0.50	sec-Butylbenzene	<1.0
1,2-Dichloroethane	<0.50	p-Isopropyltoluene	<1.0
Trichloroethene	<1.0	1,3-Dichlorobenzene	<1.0
1,2-Dichloropropane	<1.0	1,4-Dichlorobenzene	<0.50
Bromodichloromethane	<1.0	n-Butylbenzene	<1.0
Dibromomethane	<1.0	1,2-Dichlorobenzene	<1.0
Toluene	<1.0	1,2-Dibromo-3-Chloropropane	<1.0
1,1,2-Trichloroethane	<1.0	1,2,4-Trichlorobenzene	<1.0
Tetrachloroethene	2.7	Hexachlorobutadiene	<1.0
1,3-Dichloropropane	<1.0	Naphthalene	<1.0
Dibromochloromethane	<1.0	1,2,3-Trichlorobenzene	<1.0
1,2-Dibromoethane	<1.0	cis-1,3-Dichloropropene	<1.0
Chlorobenzene	<1.0	trans-1,3-Dichloropropene	<1.0
		Dichloromonofluoromethane	1.0

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA method 502.2.

*Present but less than the practical quantitation limit.

ANALYTICAL SERVICES - WATER, SOIL, PETROLEUM, COAL

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Steve Downs
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-10822
DATE: 05/23/90 dya

WATER ANALYSIS

Helena Landfill
HL-9005-105
Sampled 05/04/90 @ 0930
Submitted 05/08/90

#13

<u>Volatile Organic Constituent</u>	<u>µg/l</u>
Dichlorodifluoromethane	2.3
Chloromethane	<1.0
Vinyl chloride	<0.50
Bromomethane	<1.0
Chloroethane	<1.0
Trichlorofluoromethane	<1.0*
1,1-Dichloroethene	<0.50
Methylene Chloride	<1.0
trans-1,2-Dichloroethene	<1.0
1,1-Dichloroethane	<1.0*
2,2-Dichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0*
Chloroform	4.4
Bromochloromethane	<1.0
1,1,1-Trichloroethane	0.79
Carbon Tetrachloride	<0.50
1,1-Dichloropropene	<1.0
Benzene	<0.50
1,2-Dichloroethane	<0.50
Trichloroethene	0.74
1,2-Dichloropropane	<1.0
Bromodichloromethane	<1.0
Dibromomethane	<1.0
Toluene	<1.0
1,1,2-Trichloroethane	<1.0
Tetrachloroethene	2.3
1,3-Dichloropropane	<1.0
Dibromochloromethane	<1.0
1,2-Dibromoethane	<1.0
Chlorobenzene	<1.0

<u>Volatile Organic Constituent</u>	<u>µg/l</u>
1,1,1,2-Tetrachloroethane	<1.0
Ethylbenzene	<1.0
p-Xylene	<1.0
m-Xylene	<1.0
o-Xylene	<1.0
Styrene	<1.0
Bromoform	<1.0
Isopropylbenzene	<1.0
1,1,2,2-Tetrachloroethane	<1.0
Bromobenzene	<1.0
1,2,3-Trichloropropane	<1.0
n-Propylbenzene	<1.0
2-Chlorotoluene	<1.0
1,3,5-Trimethylbenzene	<1.0
4-Chlorotoluene	<1.0
tert-Butylbenzene	<1.0
1,2,4-Trimethylbenzene	<1.0
sec-Butylbenzene	<1.0
p-Isopropyltoluene	<1.0
1,3-Dichlorobenzene	<1.0
1,4-Dichlorobenzene	<0.50
n-Butylbenzene	<1.0
1,2-Dichlorobenzene	<1.0
1,2-Dibromo-3-Chloropropane	<1.0
1,2,4-Trichlorobenzene	<1.0
Hexachlorobutadiene	<1.0
Naphthalene	<1.0
1,2,3-Trichlorobenzene	<1.0
cis-1,3-Dichloropropene	<1.0
trans-1,3-Dichloropropene	<1.0
Dichloromonofluoromethane	1.9

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA Method 502.2

*Present but less than the practical quantitation limit.

COMPLETE ENVIRONMENTAL ANALYTICAL SERVICE

LABORATORY REPORT

LAB. NO.: 88-10022
DATE: 02/23/90 dya

TO: **Mr. Deane**
ADDRESS: **2777 Airport Road**
Hamden, CT 06517

WATER ANALYSIS
Sampled Location: **Hamden Landfill**
Sampled Date: **02/23/90**
Submitted Date: **02/23/90**
15

Volume Percent Component	Concentration	Volume Percent Component	Concentration
Chlorobenzene	<1.0	Chlorobenzene	<1.0
Chloroethane	<1.0	Chloroethane	<1.0
Chloroform	<1.0	Chloroform	<1.0
1,1-Dichloroethane	<1.0	1,1-Dichloroethane	<1.0
1,2-Dichloroethane	<1.0	1,2-Dichloroethane	<1.0
1,1,1-Trichloroethane	<1.0	1,1,1-Trichloroethane	<1.0
1,1,2-Trichloroethane	<1.0	1,1,2-Trichloroethane	<1.0
1,1,2,2-Tetrachloroethane	<1.0	1,1,2,2-Tetrachloroethane	<1.0
1,1,1,2-Tetrachloroethane	<1.0	1,1,1,2-Tetrachloroethane	<1.0
1,1,1,2,2-Pentachloroethane	<1.0	1,1,1,2,2-Pentachloroethane	<1.0
1,1,1,2,2,2-Hexachloroethane	<1.0	1,1,1,2,2,2-Hexachloroethane	<1.0
1,1,1,2,2,2,2-Heptachloroethane	<1.0	1,1,1,2,2,2,2-Heptachloroethane	<1.0
1,1,1,2,2,2,2,2-Octachloroethane	<1.0	1,1,1,2,2,2,2,2-Octachloroethane	<1.0
1,1,1,2,2,2,2,2,2-Nonachloroethane	<1.0	1,1,1,2,2,2,2,2,2-Nonachloroethane	<1.0
1,1,1,2,2,2,2,2,2,2-Decachloroethane	<1.0	1,1,1,2,2,2,2,2,2,2-Decachloroethane	<1.0
1,1,1,2,2,2,2,2,2,2,2-Undecachloroethane	<1.0	1,1,1,2,2,2,2,2,2,2,2-Undecachloroethane	<1.0
1,1,1,2,2,2,2,2,2,2,2,2-Dodecachloroethane	<1.0	1,1,1,2,2,2,2,2,2,2,2,2-Dodecachloroethane	<1.0
1,1,1,2,2,2,2,2,2,2,2,2,2-Tridecachloroethane	<1.0	1,1,1,2,2,2,2,2,2,2,2,2,2-Tridecachloroethane	<1.0
1,1,1,2,2,2,2,2,2,2,2,2,2,2-Tetradecachloroethane	<1.0	1,1,1,2,2,2,2,2,2,2,2,2,2,2-Tetradecachloroethane	<1.0
1,1,1,2,2,2,2,2,2,2,2,2,2,2,2-Pentadecachloroethane	<1.0	1,1,1,2,2,2,2,2,2,2,2,2,2,2,2-Pentadecachloroethane	<1.0
1,1,1,2,2,2,2,2,2,2,2,2,2,2,2,2-Hexadecachloroethane	<1.0	1,1,1,2,2,2,2,2,2,2,2,2,2,2,2,2-Hexadecachloroethane	<1.0
1,1,1,2,2,2,2,2,2,2,2,2,2,2,2,2,2-Heptadecachloroethane	<1.0	1,1,1,2,2,2,2,2,2,2,2,2,2,2,2,2,2-Heptadecachloroethane	<1.0
1,1,1,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2-Octadecachloroethane	<1.0	1,1,1,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2-Octadecachloroethane	<1.0
1,1,1,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2-Nonadecachloroethane	<1.0	1,1,1,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2-Nonadecachloroethane	<1.0
1,1,1,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2-Eicacosachloroethane	<1.0	1,1,1,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2-Eicacosachloroethane	<1.0
1,1,1,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2-Hentriacosachloroethane	<1.0	1,1,1,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2-Hentriacosachloroethane	<1.0
1,1,1,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2-Tetracosachloroethane	<1.0	1,1,1,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2-Tetracosachloroethane	<1.0
1,1,1,2-Pentacosachloroethane	<1.0	1,1,1,2-Pentacosachloroethane	<1.0
1,1,1,2-Hexacosachloroethane	<1.0	1,1,1,2-Hexacosachloroethane	<1.0
1,1,1,2-Heptacosachloroethane	<1.0	1,1,1,2-Heptacosachloroethane	<1.0
1,1,1,2-Octacosachloroethane	<1.0	1,1,1,2-Octacosachloroethane	<1.0
1,1,1,2-Nonacosachloroethane	<1.0	1,1,1,2-Nonacosachloroethane	<1.0
1,1,1,2-Triacontachloroethane	<1.0	1,1,1,2-Triacontachloroethane	<1.0
1,1,1,2-Triacontachloroethane	<1.0	1,1,1,2-Triacontachloroethane	<1.0

REMARKS: Sample was properly preserved and in sealed container. Sample was analyzed according to EPA Method 821.5.
*Present but less than the practical quantitation limit.
Check the analytical method used.

LABORATORY REPORT

PAGE : 1

To : Hydrometrics
Address : Attn: Steve Downs
2727 Airport Road
Helena, MT 59601

Lab No. : 91-12763
Date : 6/21/91

WATER ANALYSIS REPORT

Sample Pt Name : HL9104-100
Sample Date : 4/ 4/91
Sample Time : 11:30:00
Sample Received : 4/ 9/91

Helena Landfill

PHASE 1-Volatile Organic Constituents
EPA Method 624, Revised 06/21/91

LABORATORY DATA:

Acetone-----	(ug/l)----	<10
Acrolein-----	(ug/l)----	<10
Acrylonitrile-----	(ug/l)----	<10
Benzene-----	(ug/l)----	<0.50
Bromochloromethane-----	(ug/l)----	<1.0
Bromodichloromethane-----	(ug/l)----	<1.0
1,3-Dichloropropene-----	(ug/l)----	<1.0
1,3-Dichloropropene-----	(ug/l)----	<1.0
1,4-Difluorobenzene-----	(mg/l)----	<10
Ethanol-----	(ug/l)----	<1.0
Ethylbenzene-----	(ug/l)----	<10
Ethyl methacrylate-----	(ug/l)----	<10
4-Bromofluorobenzene-----	(ug/l)----	<1.0
Bromoform-----	(ug/l)----	<1.0
Bromomethane-----	(ug/l)----	<10
2-Butanone(Methyl Ethyl Ketone)-----	(ug/l)----	<10
Carbon disulfide-----	(ug/l)----	<0.50
Carbon Tetrachloride-----	(ug/l)----	<1.0
Chlorobenzene-----	(ug/l)----	<1.0
Dibromochloromethane-----	(ug/l)----	<1.0
Chloroethane-----	(ug/l)----	<10
2-Chloroethylvinyl ether-----	(ug/l)----	3.6
Chloroform-----	(ug/l)----	<1.0
Chloromethane-----	(ug/l)----	<1.0
Dibromomethane-----	(ug/l)----	<10
1,4-Dichloro-2-butene-----	(ug/l)----	2.4
Dichlorodifluoromethane-----	(ug/l)----	<1.0*
1,1-Dichloroethane-----	(ug/l)----	<0.50
1,2-Dichloroethane-----	(ug/l)----	<10
2-Hexanone-----	(ug/l)----	<10
Iodomethane-----	(ug/l)----	<1.0
Methylene Chloride-----	(ug/l)----	<10
Methyl-2-pentanone-----	(ug/l)----	<0.50
1,2-Dichloroethene-----	(ug/l)----	<1.0
trans-1,2-Dichloroethene-----	(ug/l)----	

LABORATORY REPORT

Lab No.: 100-100-100
 Date: 10/1/91

Project: 100-100-100
 Client: 100-100-100
 Address: 100-100-100

TEST ANALYSIS REPORT

Sample ID: 100-100-100
 Sample Name: 100-100-100
 Sample Type: 100-100-100
 Sample Quantity: 100-100-100

Method: 100-100-100
 Revision: 100-100-100

Retention Time (min)	Peak Name	Area	Height	Conc.
1.0	1,1-Dichloroethane	100	100	100
2.0	1,1-Dichloroethane	200	200	200
3.0	1,1-Dichloroethane	300	300	300
4.0	1,1-Dichloroethane	400	400	400
5.0	1,1-Dichloroethane	500	500	500
6.0	1,1-Dichloroethane	600	600	600
7.0	1,1-Dichloroethane	700	700	700
8.0	1,1-Dichloroethane	800	800	800
9.0	1,1-Dichloroethane	900	900	900
10.0	1,1-Dichloroethane	1000	1000	1000
11.0	1,1-Dichloroethane	1100	1100	1100
12.0	1,1-Dichloroethane	1200	1200	1200
13.0	1,1-Dichloroethane	1300	1300	1300
14.0	1,1-Dichloroethane	1400	1400	1400
15.0	1,1-Dichloroethane	1500	1500	1500
16.0	1,1-Dichloroethane	1600	1600	1600
17.0	1,1-Dichloroethane	1700	1700	1700
18.0	1,1-Dichloroethane	1800	1800	1800
19.0	1,1-Dichloroethane	1900	1900	1900
20.0	1,1-Dichloroethane	2000	2000	2000
21.0	1,1-Dichloroethane	2100	2100	2100
22.0	1,1-Dichloroethane	2200	2200	2200
23.0	1,1-Dichloroethane	2300	2300	2300
24.0	1,1-Dichloroethane	2400	2400	2400
25.0	1,1-Dichloroethane	2500	2500	2500
26.0	1,1-Dichloroethane	2600	2600	2600
27.0	1,1-Dichloroethane	2700	2700	2700
28.0	1,1-Dichloroethane	2800	2800	2800
29.0	1,1-Dichloroethane	2900	2900	2900
30.0	1,1-Dichloroethane	3000	3000	3000
31.0	1,1-Dichloroethane	3100	3100	3100
32.0	1,1-Dichloroethane	3200	3200	3200
33.0	1,1-Dichloroethane	3300	3300	3300
34.0	1,1-Dichloroethane	3400	3400	3400
35.0	1,1-Dichloroethane	3500	3500	3500
36.0	1,1-Dichloroethane	3600	3600	3600
37.0	1,1-Dichloroethane	3700	3700	3700
38.0	1,1-Dichloroethane	3800	3800	3800
39.0	1,1-Dichloroethane	3900	3900	3900
40.0	1,1-Dichloroethane	4000	4000	4000
41.0	1,1-Dichloroethane	4100	4100	4100
42.0	1,1-Dichloroethane	4200	4200	4200
43.0	1,1-Dichloroethane	4300	4300	4300
44.0	1,1-Dichloroethane	4400	4400	4400
45.0	1,1-Dichloroethane	4500	4500	4500
46.0	1,1-Dichloroethane	4600	4600	4600
47.0	1,1-Dichloroethane	4700	4700	4700
48.0	1,1-Dichloroethane	4800	4800	4800
49.0	1,1-Dichloroethane	4900	4900	4900
50.0	1,1-Dichloroethane	5000	5000	5000

**ENERGY
LABORATORIES**
ENERGY LABORATORIES, INC.

 P.O. BOX 30916 • 1107 SOUTH BROADWAY • BILLINGS, MT 59107-0916 • PHONE (406) 252-6325
 FAX (406) 252-6069 • 1-800-873-5227

LABORATORY REPORT

PAGE : 2

 To : Hydrometrics
 Address : Attn: Steve Downs
2727 Airport Road
Helena, MT 59601

 Lab No. : 91-12763
 Date : 6/21/91
WATER ANALYSIS REPORT

 Sample Pt Name : HL9104-100
 Sample Date : 4/ 4/91
 Sample Time : 11:30:00
 Sample Received : 4/ 9/91

Helena Landfill

 PHASE 1-Volatile Organic Constituents
 EPA Method 624, Revised 06/21/91

LABORATORY DATA:

Styrene-----	(ug/l)----	<1.0
1,1,2,2-Tetrachloroethane-----	(ug/l)----	<1.0
Toluene-----	(ug/l)----	<1.0
1,1,1-Trichloroethane-----	(ug/l)----	0.88
1,1,2-Trichloroethane-----	(ug/l)----	<1.0
1,2-Dichloroethane-----	(ug/l)----	0.50
1,1,1-Trichloroethane-----	(ug/l)----	<1.0*
1,1,2-Trichloroethane-----	(ug/l)----	<1.0
1,2,3-Trichloropropane-----	(ug/l)----	<10
Vinyl acetate-----	(ug/l)----	<0.50
Vinyl chloride-----	(ug/l)----	<1.0
Xylenes-----	(ug/l)----	3.4
Tetrachloroethene-----	(ug/l)----	

CC:

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Steve Downs
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-10823
DATE: 05/23/90 dya

WATER ANALYSIS

Helena Landfill

HL-9005-106

Sampled 05/04/90 @ 0945

Submitted 05/08/90

#19

<u>Volatile Organic Constituent</u>	<u>µg/l</u>	<u>Volatile Organic Constituent</u>	<u>µg/l</u>
Dichlorodifluoromethane	<1.0	1,1,1,2-Tetrachloroethane	<1.0
Chloromethane	<1.0	Ethylbenzene	<1.0
Vinyl chloride	<0.50	p-Xylene	<1.0
Bromomethane	<1.0	m-Xylene	<1.0
Chloroethane	<1.0	o-Xylene	<1.0
Trichlorofluoromethane	<1.0	Styrene	<1.0
1,1-Dichloroethene	<0.50	Bromoform	<1.0
Methylene Chloride	<1.0	Isopropylbenzene	<1.0
trans-1,2-Dichloroethene	<1.0	1,1,2,2-Tetrachloroethane	<1.0
1,1-Dichloroethane	<1.0	Bromobenzene	<1.0
2,2-Dichloropropane	<1.0	1,2,3-Trichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0	n-Propylbenzene	<1.0
Chloroform	<1.0	2-Chlorotoluene	<1.0
Bromochloromethane	<1.0	1,3,5-Trimethylbenzene	<1.0
1,1,1-Trichloroethane	<0.50	4-Chlorotoluene	<1.0
Carbon Tetrachloride	<0.50	tert-Butylbenzene	<1.0
1,1-Dichloropropene	<1.0	1,2,4-Trimethylbenzene	<1.0
Benzene	<0.50	sec-Butylbenzene	<1.0
1,2-Dichloroethane	<0.50	p-Isopropyltoluene	<1.0
Trichloroethene	<0.50	1,3-Dichlorobenzene	<1.0
1,2-Dichloropropane	<1.0	1,4-Dichlorobenzene	<0.50
Bromodichloromethane	<1.0	n-Butylbenzene	<1.0
Dibromomethane	<1.0	1,2-Dichlorobenzene	<1.0
Toluene	<1.0	1,2-Dibromo-3-Chloropropane	<1.0
1,1,2-Trichloroethane	<1.0	1,2,4-Trichlorobenzene	<1.0
Tetrachloroethene	<0.50	Hexachlorobutadiene	<1.0
1,3-Dichloropropane	<1.0	Naphthalene	<1.0
Dibromochloromethane	<1.0	1,2,3-Trichlorobenzene	<1.0
1,2-Dibromoethane	<1.0	cis-1,3-Dichloropropene	<1.0
Chlorobenzene	<1.0	trans-1,3-Dichloropropene	<1.0
		Dichloromonofluoromethane	<1.0

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA Method 502.2

*Present but less than the practical quantitation limit.

COMPLETE ENVIRONMENTAL ANALYTICAL SERVICE

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Steve Downs
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-10825
DATE: 05/23/90 dya

WATER ANALYSIS

Helena Landfill

HL-9005-108

Sampled 05/06/90 @ 1110

Submitted 05/08/90

20

<u>Volatile Organic Constituent</u>	<u>µg/l</u>	<u>Volatile Organic Constituent</u>	<u>µg/l</u>
Dichlorodifluoromethane	<1.0	1,1,1,2-Tetrachloroethane	<1.0
Chloromethane	<1.0	Ethylbenzene	<1.0
Vinyl chloride	<0.50	p-Xylene	<1.0
Bromomethane	<1.0	m-Xylene	<1.0
Chloroethane	<1.0	o-Xylene	<1.0
Trichlorofluoromethane	<1.0	Styrene	<1.0
1,1-Dichloroethene	<0.50	Bromoform	<1.0
Methylene Chloride	<1.0	Isopropylbenzene	<1.0
trans-1,2-Dichloroethene	<1.0	1,1,2,2-Tetrachloroethane	<1.0
1,1-Dichloroethane	<1.0	Bromobenzene	<1.0
2,2-Dichloropropane	<1.0	1,2,3-Trichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0	n-Propylbenzene	<1.0
Chloroform	<1.0	2-Chlorotoluene	<1.0
Bromochloromethane	<1.0	1,3,5-Trimethylbenzene	<1.0
1,1,1-Trichloroethane	<0.50	4-Chlorotoluene	<1.0
Carbon Tetrachloride	<0.50	tert-Butylbenzene	<1.0
1,1-Dichloropropene	<1.0	1,2,4-Trimethylbenzene	<1.0
Benzene	<0.50	sec-Butylbenzene	<1.0
1,2-Dichloroethane	<0.50	p-Isopropyltoluene	<1.0
Trichloroethene	<0.50	1,3-Dichlorobenzene	<1.0
1,2-Dichloropropane	<1.0	1,4-Dichlorobenzene	<0.50
Bromodichloromethane	<1.0	n-Butylbenzene	<1.0
Dibromomethane	<1.0	1,2-Dichlorobenzene	<1.0
Toluene	<1.0	1,2-Dibromo-3-Chloropropane	<1.0
1,1,2-Trichloroethane	<1.0	1,2,4-Trichlorobenzene	<1.0
Tetrachloroethene	<0.50	Hexachlorobutadiene	<1.0
1,3-Dichloropropane	<1.0	Naphthalene	<1.0
Dibromochloromethane	<1.0	1,2,3-Trichlorobenzene	<1.0
1,2-Dibromoethane	<1.0	cis-1,3-Dichloropropene	<1.0
Chlorobenzene	<1.0	trans-1,3-Dichloropropene	<1.0
		Dichloromonofluoromethane	<1.0

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA Method 502.2

*Present but less than the practical quantitation limit.

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Steve Downs
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-10826
DATE: 05/23/90 dya

WATER ANALYSIS

Helena Landfill
HL-9005-109

Sampled 05/06/90 @ 1115
Submitted 05/08/90

#23

<u>Volatile Organic Constituent</u>	<u>µg/l</u>	<u>Volatile Organic Constituent</u>	<u>µg/l</u>
Dichlorodifluoromethane	6.6	1,1,1,2-Tetrachloroethane	<1.0
Chloromethane	<1.0	Ethylbenzene	<1.0
Vinyl chloride	<0.50	p-Xylene	<1.0
Bromomethane	<1.0	m-Xylene	<1.0
Chloroethane	<1.0	o-Xylene	<1.0
Trichlorofluoromethane	<1.0*	Styrene	<1.0
1,1-Dichloroethene	<0.50*	Bromoform	<1.0
Methylene Chloride	1.1	Isopropylbenzene	<1.0
trans-1,2-Dichloroethene	<1.0	1,1,2,2-Tetrachloroethane	<1.0
1,1-Dichloroethane	1.1	Bromobenzene	<1.0
2,2-Dichloropropane	<1.0	1,2,3-Trichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0*	n-Propylbenzene	<1.0
Chloroform	7.0	2-Chlorotoluene	<1.0
Bromochloromethane	<1.0	1,3,5-Trimethylbenzene	<1.0
1,1,1-Trichloroethane	1.9	4-Chlorotoluene	<1.0
Carbon Tetrachloride	<0.50	tert-Butylbenzene	<1.0
1,1-Dichloropropene	<1.0	1,2,4-Trimethylbenzene	<1.0
Benzene	<0.50	sec-Butylbenzene	<1.0
1,2-Dichloroethane	<0.50	p-Isopropyltoluene	<1.0
Trichloroethene	1.8	1,3-Dichlorobenzene	<1.0
1,2-Dichloropropane	<1.0	1,4-Dichlorobenzene	<0.50
Bromodichloromethane	<1.0*	n-Butylbenzene	<1.0
Dibromomethane	<1.0	1,2-Dichlorobenzene	<1.0
Toluene	<1.0	1,2-Dibromo-3-Chloropropane	<1.0
1,1,2-Trichloroethane	<1.0	1,2,4-Trichlorobenzene	<1.0
Tetrachloroethene	8.1	Hexachlorobutadiene	<1.0
1,3-Dichloropropane	<1.0	Naphthalene	<1.0
Dibromochloromethane	<1.0	1,2,3-Trichlorobenzene	<1.0
1,2-Dibromoethane	<1.0	cis-1,3-Dichloropropene	<1.0
Chlorobenzene	<1.0	trans-1,3-Dichloropropene	<1.0
		Dichloromonofluoromethane	4.5

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA Method 502.2.

*Present but less than the practical quantitation limit.

COMPLETE ENVIRONMENTAL ANALYTICAL SERVICE

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Steve Downs
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-10817
DATE: 05/23/90 dya

WATER ANALYSIS

Helena Landfill

HL-9005-100

Sampled 05/03/90 @ 1100

Submitted 05/08/90

26

<u>Volatile Organic Constituent</u>	<u>µg/l</u>	<u>Volatile Organic Constituent</u>	<u>µg/l</u>
Dichlorodifluoromethane	<1.0	1,1,1,2-Tetrachloroethane	<1.0
Chloromethane	<1.0	Ethylbenzene	<1.0
Vinyl chloride	<0.50	p-Xylene	<1.0
Bromomethane	<1.0	m-Xylene	<1.0
Chloroethane	<1.0	o-Xylene	<1.0
Trichlorofluoromethane	<1.0	Styrene	<1.0
1,1-Dichloroethene	<0.50	Bromoform	<1.0
Methylene Chloride	<1.0	Isopropylbenzene	<1.0
trans-1,2-Dichloroethene	<1.0	1,1,2,2-Tetrachloroethane	<1.0
1,1-Dichloroethane	<1.0	Bromobenzene	<1.0
2,2-Dichloropropane	<1.0	1,2,3-Trichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0	n-Propylbenzene	<1.0
Chloroform	<1.0	2-Chlorotoluene	<1.0
Bromochloromethane	<1.0	1,3,5-Trimethylbenzene	<1.0
1,1,1-Trichloroethane	<0.50	4-Chlorotoluene	<1.0
Carbon Tetrachloride	<0.50	tert-Butylbenzene	<1.0
1,1-Dichloropropene	<1.0	1,2,4-Trimethylbenzene	<1.0
Benzene	<0.50	sec-Butylbenzene	<1.0
1,2-Dichloroethane	<0.50	p-Isopropyltoluene	<1.0
Trichloroethene	<0.50	1,3-Dichlorobenzene	<1.0
1,2-Dichloropropane	<1.0	1,4-Dichlorobenzene	<0.50
Bromodichloromethane	<1.0	n-Butylbenzene	<1.0
Dibromomethane	<1.0	1,2-Dichlorobenzene	<1.0
Toluene	<1.0	1,2-Dibromo-3-Chloropropane	<1.0
1,1,2-Trichloroethane	<1.0	1,2,4-Trichlorobenzene	<1.0
Tetrachloroethene	<0.50	Hexachlorobutadiene	<1.0
1,3-Dichloropropane	<1.0	Naphthalene	<1.0
Dibromochloromethane	<1.0	1,2,3-Trichlorobenzene	<1.0
1,2-Dibromoethane	<1.0	cis-1,3-Dichloropropene	<1.0
Chlorobenzene	<1.0	trans-1,3-Dichloropropene	<1.0
		Dichloromonofluoromethane	<1.0

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA Method 502.2

*Present but less than the practical quantitation limit.

COMPLETE ENVIRONMENTAL ANALYTICAL SERVICE

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Randy Huffsmith
2727 Airport Road
Helena, MT 59601LAB NO.: 90-15038
DATE: 06/18/90 dyaWATER ANALYSISHelena City Landfill
HL-9006-100

Sampled 06/05/90 @ 1030

Submitted 06/07/90

28

<u>Volatile Organic Constituent</u>	<u>µg/l</u>	<u>Volatile Organic Constituent</u>	<u>µg/l</u>
Dichlorodifluoromethane	<1.0	1,1,1,2-Tetrachloroethane	<1.0
Chloromethane	<1.0	Ethylbenzene	<1.0
Vinyl chloride	<0.50	p-Xylene	<1.0
Bromomethane	<1.0	m-Xylene	<1.0
Chloroethane	<1.0	o-Xylene	<1.0
Trichlorofluoromethane	<1.0	Styrene	<1.0
1,1-Dichloroethene	<0.50	Bromoform	<1.0*
Methylene Chloride	<1.0	Isopropylbenzene	<1.0
trans-1,2-Dichloroethene	<1.0	1,1,2,2-Tetrachloroethane	<1.0
1,1-Dichloroethane	<1.0	Bromobenzene	<1.0
2,2-Dichloropropane	<1.0	1,2,3-Trichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0	n-Propylbenzene	<1.0
Chloroform	14	2-Chlorotoluene	<1.0
Bromochloromethane	<1.0	1,3,5-Trimethylbenzene	<1.0
1,1,1-Trichloroethane	<0.50	4-Chlorotoluene	<1.0
Carbon Tetrachloride	<0.50	tert-Butylbenzene	<1.0
1,1-Dichloropropene	<1.0	1,2,4-Trimethylbenzene	<1.0
Benzene	<0.50	sec-Butylbenzene	<1.0
1,2-Dichloroethane	<0.50	p-Isopropyltoluene	<1.0
Trichloroethene	<0.50*	1,3-Dichlorobenzene	<1.0
1,2-Dichloropropane	<1.0	1,4-Dichlorobenzene	<0.50
Bromodichloromethane	1.9	n-Butylbenzene	<1.0
Dibromomethane	<1.0	1,2-Dichlorobenzene	<1.0
Toluene	<1.0	1,2-Dibromo-3-Chloropropane	<1.0
1,1,2-Trichloroethane	<1.0	1,2,4-Trichlorobenzene	<1.0
Tetrachloroethene	7.4	Hexachlorobutadiene	<1.0
1,3-Dichloropropane	<1.0	Naphthalene	<1.0
Dibromochloromethane	<1.0*	1,2,3-Trichlorobenzene	<1.0
1,2-Dibromoethane	<1.0	cis-1,3-Dichloropropene	<1.0
Chlorobenzene	<1.0	trans-1,3-Dichloropropene	<1.0
		Dichloromonofluoromethane	<1.0

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA Method 502.2.

*Present but less than the practical quantitation limit.

COMPLETE ENVIRONMENTAL ANALYTICAL SERVICE

LABORATORY REPORT

LAB NO: 80-0000
DATE: 06/19/80

TO:
ADDRESS:
757 5th Ave.
New York, NY 10017

WATER ANALYSIS

Sample ID: 1000

Sample Date: 06/19/80

Sample Location: 1000

#12

Concentration	Concentration	Concentration
1.1, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100	1.1, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100	1.1, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed according to EPA Method 815.

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Steve Downs
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-10820
DATE: 05/23/90 dya

WATER ANALYSIS

Helena Landfill
HL-9005-103
Sampled 05/03/90 @ 1250
Submitted 05/08/90

31

<u>Volatile Organic Constituent</u>	<u>µg/l</u>	<u>Volatile Organic Constituent</u>	<u>µg/l</u>
Dichlorodifluoromethane	<1.0	1,1,1,2-Tetrachloroethane	<1.0
Chloromethane	<1.0	Ethylbenzene	<1.0
Vinyl chloride	<0.50	p-Xylene	<1.0
Bromomethane	<1.0	m-Xylene	<1.0
Chloroethane	<1.0	o-Xylene	<1.0
Trichlorofluoromethane	<1.0	Styrene	<1.0
1,1-Dichloroethene	<0.50	Bromoform	<1.0
Methylene Chloride	<1.0	Isopropylbenzene	<1.0
trans-1,2-Dichloroethene	<1.0	1,1,2,2-Tetrachloroethane	<1.0
1,1-Dichloroethane	<1.0	Bromobenzene	<1.0
2,2-Dichloropropane	<1.0	1,2,3-Trichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0	n-Propylbenzene	<1.0
Chloroform	10.0	2-Chlorotoluene	<1.0
Bromochloromethane	<1.0	1,3,5-Trimethylbenzene	<1.0
1,1,1-Trichloroethane	<0.50	4-Chlorotoluene	<1.0
Carbon Tetrachloride	<0.50	tert-Butylbenzene	<1.0
1,1-Dichloropropene	<1.0	1,2,4-Trimethylbenzene	<1.0
Benzene	<0.50	sec-Butylbenzene	<1.0
1,2-Dichloroethane	<0.50	p-Isopropyltoluene	<1.0
Trichloroethene	<0.50	1,3-Dichlorobenzene	<1.0
1,2-Dichloropropane	<1.0	1,4-Dichlorobenzene	<0.50
Bromodichloromethane	<1.0*	n-Butylbenzene	<1.0
Dibromomethane	<1.0	1,2-Dichlorobenzene	<1.0
Toluene	<1.0	1,2-Dibromo-3-Chloropropane	<1.0
1,1,2-Trichloroethane	<1.0	1,2,4-Trichlorobenzene	<1.0
Tetrachloroethene	0.60	Hexachlorobutadiene	<1.0
1,3-Dichloropropane	<1.0	Naphthalene	<1.0
Dibromochloromethane	<1.0	1,2,3-Trichlorobenzene	<1.0
1,2-Dibromoethane	<1.0	cis-1,3-Dichloropropene	<1.0
Chlorobenzene	<1.0	trans-1,3-Dichloropropene	<1.0
		Dichloromonofluoromethane	<1.0

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA Method 502.2

*Present but less than the practical quantitation limit.

COMPLETE ENVIRONMENTAL ANALYTICAL SERVICE

LABORATORY REPORT

LAB NO.: 10-10550
DATE: 08/23/93

TO: [REDACTED]
ADDRESS: [REDACTED]
3757 Route 100
Haines, NJ 07033

WATER ANALYSIS

Sampled 08/23/93 @ 1:30
Submitted 08/23/93

21

Concentration	Concentration	Concentration
Chlorobenzene	<1.0	Chlorobenzene
1,2-Dichlorobenzene	<1.0	1,2-Dichlorobenzene
1,4-Dichlorobenzene	<1.0	1,4-Dichlorobenzene
Bromobenzene	<1.0	Bromobenzene
Vinyl chloride	<1.0	Vinyl chloride
Chloroethane	<1.0	Chloroethane
1,1,1-Trichloroethane	<1.0	1,1,1-Trichloroethane
1,1,2-Trichloroethane	<1.0	1,1,2-Trichloroethane
Methylene chloride	<1.0	Methylene chloride
trans-1,2-Dichloroethane	<1.0	trans-1,2-Dichloroethane
1,1-Dichloroethane	<1.0	1,1-Dichloroethane
2,2-Dichloropropane	<1.0	2,2-Dichloropropane
1,1,1,3-Tetrachloroethane	<1.0	1,1,1,3-Tetrachloroethane
1,1,2,2-Tetrachloroethane	<1.0	1,1,2,2-Tetrachloroethane
1,1,2,3-Tetrachloroethane	<1.0	1,1,2,3-Tetrachloroethane
1,1,2,4-Tetrachloroethane	<1.0	1,1,2,4-Tetrachloroethane
1,1,3,3-Tetrachloroethane	<1.0	1,1,3,3-Tetrachloroethane
1,1,1,2-Tetrachloroethane	<1.0	1,1,1,2-Tetrachloroethane
1,1,1,3,3-Pentachloroethane	<1.0	1,1,1,3,3-Pentachloroethane
1,1,1,2,2-Pentachloroethane	<1.0	1,1,1,2,2-Pentachloroethane
1,1,1,2,3-Pentachloroethane	<1.0	1,1,1,2,3-Pentachloroethane
1,1,1,2,4-Pentachloroethane	<1.0	1,1,1,2,4-Pentachloroethane
1,1,1,3,4-Pentachloroethane	<1.0	1,1,1,3,4-Pentachloroethane
1,1,2,2,3-Pentachloroethane	<1.0	1,1,2,2,3-Pentachloroethane
1,1,2,2,4-Pentachloroethane	<1.0	1,1,2,2,4-Pentachloroethane
1,1,2,3,4-Pentachloroethane	<1.0	1,1,2,3,4-Pentachloroethane
1,1,1,2,3,4-Hexachloroethane	<1.0	1,1,1,2,3,4-Hexachloroethane
1,1,1,2,3,5-Hexachloroethane	<1.0	1,1,1,2,3,5-Hexachloroethane
1,1,1,2,4,5-Hexachloroethane	<1.0	1,1,1,2,4,5-Hexachloroethane
1,1,1,3,4,5-Hexachloroethane	<1.0	1,1,1,3,4,5-Hexachloroethane
1,1,2,2,3,4-Hexachloroethane	<1.0	1,1,2,2,3,4-Hexachloroethane
1,1,2,2,3,5-Hexachloroethane	<1.0	1,1,2,2,3,5-Hexachloroethane
1,1,2,2,4,5-Hexachloroethane	<1.0	1,1,2,2,4,5-Hexachloroethane
1,1,2,3,4,5-Hexachloroethane	<1.0	1,1,2,3,4,5-Hexachloroethane
1,1,1,2,3,4,5-Heptachloroethane	<1.0	1,1,1,2,3,4,5-Heptachloroethane
1,1,1,2,3,4,6-Heptachloroethane	<1.0	1,1,1,2,3,4,6-Heptachloroethane
1,1,1,2,3,5,6-Heptachloroethane	<1.0	1,1,1,2,3,5,6-Heptachloroethane
1,1,1,2,4,5,6-Heptachloroethane	<1.0	1,1,1,2,4,5,6-Heptachloroethane
1,1,1,3,4,5,6-Heptachloroethane	<1.0	1,1,1,3,4,5,6-Heptachloroethane
1,1,2,2,3,4,5-Heptachloroethane	<1.0	1,1,2,2,3,4,5-Heptachloroethane
1,1,2,2,3,4,6-Heptachloroethane	<1.0	1,1,2,2,3,4,6-Heptachloroethane
1,1,2,2,3,5,6-Heptachloroethane	<1.0	1,1,2,2,3,5,6-Heptachloroethane
1,1,2,2,4,5,6-Heptachloroethane	<1.0	1,1,2,2,4,5,6-Heptachloroethane
1,1,2,3,4,5,6-Heptachloroethane	<1.0	1,1,2,3,4,5,6-Heptachloroethane
1,1,1,2,3,4,5,6-Octachloroethane	<1.0	1,1,1,2,3,4,5,6-Octachloroethane
1,1,1,2,3,4,5,7-Octachloroethane	<1.0	1,1,1,2,3,4,5,7-Octachloroethane
1,1,1,2,3,4,6,7-Octachloroethane	<1.0	1,1,1,2,3,4,6,7-Octachloroethane
1,1,1,2,3,5,6,7-Octachloroethane	<1.0	1,1,1,2,3,5,6,7-Octachloroethane
1,1,1,2,4,5,6,7-Octachloroethane	<1.0	1,1,1,2,4,5,6,7-Octachloroethane
1,1,1,3,4,5,6,7-Octachloroethane	<1.0	1,1,1,3,4,5,6,7-Octachloroethane
1,1,2,2,3,4,5,6-Octachloroethane	<1.0	1,1,2,2,3,4,5,6-Octachloroethane
1,1,2,2,3,4,6,7-Octachloroethane	<1.0	1,1,2,2,3,4,6,7-Octachloroethane
1,1,2,2,3,5,6,7-Octachloroethane	<1.0	1,1,2,2,3,5,6,7-Octachloroethane
1,1,2,2,4,5,6,7-Octachloroethane	<1.0	1,1,2,2,4,5,6,7-Octachloroethane
1,1,2,3,4,5,6,7-Octachloroethane	<1.0	1,1,2,3,4,5,6,7-Octachloroethane

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed according with EPA Method 8022.

*Present but less than the detection quantitation limit

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Steve Downs
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-10820 dup
DATE: 05/23/90 dya

QUALITY ASSURANCE - DUPLICATE ANALYSIS

Helena Landfill

HL-9005-103

Sampled 05/03/90 @ 1250

Submitted 05/08/90

Dup # 31

<u>Volatile Organic Constituent</u>	<u>µg/l</u>	<u>Volatile Organic Constituent</u>	<u>µg/l</u>
Dichlorodifluoromethane	<1.0	1,1,1,2-Tetrachloroethane	<1.0
Chloromethane	<1.0	Ethylbenzene	<1.0
Vinyl chloride	<0.50	p-Xylene	<1.0
Bromomethane	<1.0	m-Xylene	<1.0
Chloroethane	<1.0	o-Xylene	<1.0
Trichlorofluoromethane	<1.0	Styrene	<1.0
1,1-Dichloroethene	<0.50	Bromoform	<1.0
Methylene Chloride	<1.0	Isopropylbenzene	<1.0
trans-1,2-Dichloroethene	<1.0	1,1,2,2-Tetrachloroethane	<1.0
1,1-Dichloroethane	<1.0	Bromobenzene	<1.0
2,2-Dichloropropane	<1.0	1,2,3-Trichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0	n-Propylbenzene	<1.0
Chloroform	9.9	2-Chlorotoluene	<1.0
Bromochloromethane	<1.0	1,3,5-Trimethylbenzene	<1.0
1,1,1-Trichloroethane	<0.50	4-Chlorotoluene	<1.0
Carbon Tetrachloride	<0.50	tert-Butylbenzene	<1.0
1,1-Dichloropropene	<1.0	1,2,4-Trimethylbenzene	<1.0
Benzene	<0.50	sec-Butylbenzene	<1.0
1,2-Dichloroethane	<0.50	p-Isopropyltoluene	<1.0
Trichloroethene	<0.50	1,3-Dichlorobenzene	<1.0
1,2-Dichloropropane	<1.0	1,4-Dichlorobenzene	<0.50
Bromodichloromethane	<1.0*	n-Butylbenzene	<1.0
Dibromomethane	<1.0	1,2-Dichlorobenzene	<1.0
Toluene	<1.0	1,2-Dibromo-3-Chloropropane	<1.0
1,1,2-Trichloroethane	<1.0	1,2,4-Trichlorobenzene	<1.0
Tetrachloroethene	0.55	Hexachlorobutadiene	<1.0
1,3-Dichloropropane	<1.0	Naphthalene	<1.0
Dibromochloromethane	<1.0	1,2,3-Trichlorobenzene	<1.0
1,2-Dibromoethane	<1.0	cis-1,3-Dichloropropene	<1.0
Chlorobenzene	<1.0	trans-1,3-Dichloropropene	<1.0
		Dichloromonofluoromethane	<1.0

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA Method 502.2

*Present but less than the practical quantitation limit.

COMPLETE ENVIRONMENTAL ANALYTICAL SERVICE

LABORATORY REPORT

PAGE : 1

 To : Hydrometrics
 Address : Attn: Steve Downs
2727 Airport Road
Helena, MT 59061

 Lab No. : 91-13088
 Date : 6/14/91
WATER ANALYSIS REPORT

 Sample Pt Name : HL9104-111
 Sample Date : 4/13/91
 Sample Time : 13:20:00
 Sample Received : 4/16/91
Helena Landfill
 Revised 06/14/91

LABORATORY DATA:

Acetone-----	(ug/l)----	<10
Acrolein-----	(ug/l)----	<10
Acrylonitrile-----	(ug/l)----	<10
Benzene-----	(ug/l)----	<0.50
Bromochloromethane-----	(ug/l)----	<1.0
Bromodichloromethane-----	(ug/l)----	<1.0
1,3-Dichloropropene-----	(ug/l)----	<1.0
trans-1,3-Dichloropropene-----	(ug/l)----	<1.0
1,4-Difluorobenzene-----	(ug/l)----	<10
Ethanol-----	(mg/l)----	<10
Ethylbenzene-----	(ug/l)----	<1.0
Ethyl methacrylate-----	(ug/l)----	<10
4-Bromofluorobenzene-----	(ug/l)----	<10
Bromoform-----	(ug/l)----	<1.0
Bromomethane-----	(ug/l)----	<1.0
2-Butanone(Methyl Ethyl Ketone)-----	(ug/l)----	<10
Carbon disulfide-----	(ug/l)----	<10
Carbon Tetrachloride-----	(ug/l)----	<0.50
Chlorobenzene-----	(ug/l)----	<1.0
Dibromochloromethane-----	(ug/l)----	<1.0
Chloroethane-----	(ug/l)----	<1.0
2-Chloroethylvinyl ether-----	(ug/l)----	<10
Chloroform-----	(ug/l)----	7.7
Chloromethane-----	(ug/l)----	<1.0
Dibromomethane-----	(ug/l)----	<1.0
1,4-Dichloro-2-butene-----	(ug/l)----	<10
Dichlorodifluoromethane-----	(ug/l)----	<1.0
1,1-Dichloroethane-----	(ug/l)----	<1.0
1,2-Dichloroethane-----	(ug/l)----	<0.50
2-Hexanone-----	(ug/l)----	<10
Iodomethane-----	(ug/l)----	<10
Methylene Chloride-----	(ug/l)----	<1.0
Methyl-2-pentanone-----	(ug/l)----	<10
1,2-Dichloroethene-----	(ug/l)----	<0.50
trans-1,2-Dichloroethene-----	(ug/l)----	<1.0
Styrene-----	(ug/l)----	<1.0

LABORATORY REPORT

PAGE : 2

To : Hydrometrics
Address : Attn: Steve Downs
2727 Airport Road
Helena, MT 59061

Lab No. : 91-13088
Date : 6/14/91

WATER ANALYSIS REPORT

Sample Pt Name : HL9104-111
Sample Date : 4/13/91
Sample Time : 13:20:00
Sample Received : 4/16/91
Helena Landfill
Revised 06/14/91

LABORATORY DATA:

1,1,2,2-Tetrachloroethane-----	(ug/l)----	<1.0
Tetrachloroethene-----	(ug/l)----	<0.50*
Toluene-----	(ug/l)----	<1.0
1,1,1-Trichloroethane-----	(ug/l)----	<0.50
1,1,2-Trichloroethane-----	(ug/l)----	<1.0
Trichloroethene-----	(ug/l)----	<0.50
Chlorofluoromethane-----	(ug/l)----	<1.0
1,3-Trichloropropane-----	(ug/l)----	<1.0
Vinyl acetate-----	(ug/l)----	<10
Vinyl chloride-----	(ug/l)----	<0.50
Xylenes-----	(ug/l)----	<1.0

*Present but less than the practical quantitation limits.

CC:

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Steve Downs
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-10818
DATE: 05/23/90 dya

WATER ANALYSIS

Helena Landfill

HL-9005-101

Sampled 05/03/90 @ 1140

Submitted 05/08/90

#32

<u>Volatile Organic Constituent</u>	<u>µg/l</u>	<u>Volatile Organic Constituent</u>	<u>µg/l</u>
Dichlorodifluoromethane	<1.0	1,1,1,2-Tetrachloroethane	<1.0
Chloromethane	<1.0	Ethylbenzene	<1.0
Vinyl chloride	<0.50	p-Xylene	<1.0
Bromomethane	<1.0	m-Xylene	<1.0
Chloroethane	<1.0	o-Xylene	<1.0
Trichlorofluoromethane	<1.0	Styrene	<1.0
1,1-Dichloroethene	<0.50	Bromoform	<1.0
Methylene Chloride	<1.0	Isopropylbenzene	<1.0
trans-1,2-Dichloroethene	<1.0	1,1,2,2-Tetrachloroethane	<1.0
1,1-Dichloroethane	<1.0	Bromobenzene	<1.0
2,2-Dichloropropane	<1.0	1,2,3-Trichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0	n-Propylbenzene	<1.0
Chloroform	<1.0	2-Chlorotoluene	<1.0
Bromochloromethane	<1.0	1,3,5-Trimethylbenzene	<1.0
1,1,1-Trichloroethane	<0.50	4-Chlorotoluene	<1.0
Carbon Tetrachloride	<0.50	tert-Butylbenzene	<1.0
1,1-Dichloropropene	<1.0	1,2,4-Trimethylbenzene	<1.0
Benzene	<0.50	sec-Butylbenzene	<1.0
1,2-Dichloroethane	<0.50	p-Isopropyltoluene	<1.0
Trichloroethene	<0.50	1,3-Dichlorobenzene	<1.0
1,2-Dichloropropane	<1.0	1,4-Dichlorobenzene	<0.50
Bromodichloromethane	<1.0	n-Butylbenzene	<1.0
Dibromomethane	<1.0	1,2-Dichlorobenzene	<1.0
Toluene	<1.0	1,2-Dibromo-3-Chloropropane	<1.0
1,1,2-Trichloroethane	<1.0	1,2,4-Trichlorobenzene	<1.0
Tetrachloroethene	<0.50	Hexachlorobutadiene	<1.0
1,3-Dichloropropane	<1.0	Naphthalene	<1.0
Dibromochloromethane	<1.0	1,2,3-Trichlorobenzene	<1.0
1,2-Dibromoethane	<1.0	cis-1,3-Dichloropropene	<1.0
Chlorobenzene	<1.0	trans-1,3-Dichloropropene	<1.0
		Dichloromonofluoromethane	<1.0

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA Method 502.2

*Present but less than the practical quantitation limit

COMPLETE ENVIRONMENTAL ANALYTICAL SERVICE

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Steve Downs
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-10824
DATE: 05/23/90 dya

WATER ANALYSIS

Helena Landfill

HL-9005-107

Sampled 05/06/90 @ 1100

Submitted 05/08/90

34

<u>Volatile Organic Constituent</u>	<u>µg/l</u>	<u>Volatile Organic Constituent</u>	<u>µg/l</u>
Dichlorodifluoromethane	<1.0	1,1,1,2-Tetrachloroethane	<1.0
Chloromethane	<1.0	Ethylbenzene	<1.0
Vinyl chloride	<0.50	p-Xylene	<1.0
Bromomethane	<1.0	m-Xylene	<1.0
Chloroethane	<1.0	o-Xylene	<1.0
Trichlorofluoromethane	<1.0	Styrene	<1.0
1,1-Dichloroethene	<0.50	Bromoform	<1.0
Methylene Chloride	<1.0	Isopropylbenzene	<1.0
trans-1,2-Dichloroethene	<1.0	1,1,2,2-Tetrachloroethane	<1.0
1,1-Dichloroethane	<1.0	Bromobenzene	<1.0
2,2-Dichloropropane	<1.0	1,2,3-Trichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0	n-Propylbenzene	<1.0
Chloroform	5.6	2-Chlorotoluene	<1.0
Bromochloromethane	<1.0	1,3,5-Trimethylbenzene	<1.0
1,1,1-Trichloroethane	<0.50	4-Chlorotoluene	<1.0
Carbon Tetrachloride	<0.50	tert-Butylbenzene	<1.0
1,1-Dichloropropene	<1.0	1,2,4-Trimethylbenzene	<1.0
Benzene	<0.50	sec-Butylbenzene	<1.0
1,2-Dichloroethane	<0.50	p-Isopropyltoluene	<1.0
Trichloroethene	<0.50	1,3-Dichlorobenzene	<1.0
1,2-Dichloropropane	<1.0	1,4-Dichlorobenzene	<0.50
Bromodichloromethane	<1.0	n-Butylbenzene	<1.0
Dibromomethane	<1.0	1,2-Dichlorobenzene	<1.0
Toluene	<1.0	1,2-Dibromo-3-Chloropropane	<1.0
1,1,2-Trichloroethane	<1.0	1,2,4-Trichlorobenzene	<1.0
Tetrachloroethene	2.2	Hexachlorobutadiene	<1.0
1,3-Dichloropropane	<1.0	Naphthalene	<1.0
Dibromochloromethane	<1.0	1,2,3-Trichlorobenzene	<1.0
1,2-Dibromoethane	<1.0	cis-1,3-Dichloropropene	<1.0
Chlorobenzene	<1.0	trans-1,3-Dichloropropene	<1.0
		Dichloromonofluoromethane	<1.0

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA Method 502.2

*Present but less than the practical quantitation limit.

COMPLETE ENVIRONMENTAL ANALYTICAL SERVICE

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Steve Downs
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-10824
DATE: 05/23/90 dya

WATER ANALYSIS

Helena Landfill

HL-9005-107

Sampled 05/06/90 @ 1100

Submitted 05/08/90

#34

<u>Volatile Organic Constituent</u>	<u>µg/l</u>	<u>Volatile Organic Constituent</u>	<u>µg/l</u>
Dichlorodifluoromethane	<1.0	1,1,1,2-Tetrachloroethane	<1.0
Chloromethane	<1.0	Ethylbenzene	<1.0
Vinyl chloride	<0.50	p-Xylene	<1.0
Bromomethane	<1.0	m-Xylene	<1.0
Chloroethane	<1.0	o-Xylene	<1.0
Trichlorofluoromethane	<1.0	Styrene	<1.0
1,1-Dichloroethene	<0.50	Bromoform	<1.0
Methylene Chloride	<1.0	Isopropylbenzene	<1.0
trans-1,2-Dichloroethene	<1.0	1,1,2,2-Tetrachloroethane	<1.0
1,1-Dichloroethane	<1.0	Bromobenzene	<1.0
2,2-Dichloropropane	<1.0	1,2,3-Trichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0	n-Propylbenzene	<1.0
Chloroform	5.6	2-Chlorotoluene	<1.0
Bromochloromethane	<1.0	1,3,5-Trimethylbenzene	<1.0
1,1,1-Trichloroethane	<0.50	4-Chlorotoluene	<1.0
Carbon Tetrachloride	<0.50	tert-Butylbenzene	<1.0
1,1-Dichloropropene	<1.0	1,2,4-Trimethylbenzene	<1.0
Benzene	<0.50	sec-Butylbenzene	<1.0
1,2-Dichloroethane	<0.50	p-Isopropyltoluene	<1.0
Trichloroethene	<0.50	1,3-Dichlorobenzene	<1.0
1,2-Dichloropropane	<1.0	1,4-Dichlorobenzene	<0.50
Bromodichloromethane	<1.0	n-Butylbenzene	<1.0
Dibromomethane	<1.0	1,2-Dichlorobenzene	<1.0
Toluene	<1.0	1,2-Dibromo-3-Chloropropane	<1.0
1,1,2-Trichloroethane	<1.0	1,2,4-Trichlorobenzene	<1.0
Tetrachloroethene	2.2	Hexachlorobutadiene	<1.0
1,3-Dichloropropane	<1.0	Naphthalene	<1.0
Dibromochloromethane	<1.0	1,2,3-Trichlorobenzene	<1.0
1,2-Dibromoethane	<1.0	cis-1,3-Dichloropropene	<1.0
Chlorobenzene	<1.0	trans-1,3-Dichloropropene	<1.0
		Dichloromonofluoromethane	<1.0

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA Method 502.2

*Present but less than the practical quantitation limit.

COMPLETE ENVIRONMENTAL ANALYTICAL SERVICE

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Randy Huffsmith
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-15040
DATE: 06/18/90 dya

WATER ANALYSIS

Helena City Landfill
HL-9006-102

Sampled 06/05/90 @ 1100

Submitted 06/07/90

#36

Volatile Organic Constituent

	<u>µg/l</u>
Dichlorodifluoromethane	<1.0
Chloromethane	<1.0
Vinyl chloride	<0.50
Bromomethane	<1.0
Chloroethane	<1.0
Trichlorofluoromethane	<1.0
1,1-Dichloroethene	<0.50
Methylene Chloride	<1.0
trans-1,2-Dichloroethene	<1.0
1,1-Dichloroethane	<1.0
2,2-Dichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0
Chloroform	<1.0
Bromochloromethane	<1.0
1,1,1-Trichloroethane	<0.50
Carbon Tetrachloride	<0.50
1,1-Dichloropropene	<1.0
Benzene	<0.50
1,2-Dichloroethane	<0.50
Trichloroethene	<1.0
1,2-Dichloropropane	<1.0
Bromodichloromethane	<1.0
Dibromomethane	<1.0
Toluene	<1.0
1,1,2-Trichloroethane	<1.0
Tetrachloroethene	<0.50
1,3-Dichloropropane	<1.0
Dibromochloromethane	<1.0
1,2-Dibromoethane	<1.0
Chlorobenzene	<1.0

Volatile Organic Constituent

	<u>µg/l</u>
1,1,1,2-Tetrachloroethane	<1.0
Ethylbenzene	<1.0
p-Xylene	<1.0
m-Xylene	<1.0
o-Xylene	<1.0
Styrene	<1.0
Bromoform	<1.0
Isopropylbenzene	<1.0
1,1,2,2-Tetrachloroethane	<1.0
Bromobenzene	<1.0
1,2,3-Trichloropropane	<1.0
n-Propylbenzene	<1.0
2-Chlorotoluene	<1.0
1,3,5-Trimethylbenzene	<1.0
4-Chlorotoluene	<1.0
tert-Butylbenzene	<1.0
1,2,4-Trimethylbenzene	<1.0
sec-Butylbenzene	<1.0
p-Isopropyltoluene	<1.0
1,3-Dichlorobenzene	<1.0
1,4-Dichlorobenzene	<0.50
n-Butylbenzene	<1.0
1,2-Dichlorobenzene	<1.0
1,2-Dibromo-3-Chloropropane	<1.0
1,2,4-Trichlorobenzene	<1.0
Hexachlorobutadiene	<1.0
Naphthalene	<1.0
1,2,3-Trichlorobenzene	<1.0
cis-1,3-Dichloropropene	<1.0
trans-1,3-Dichloropropene	<1.0
Dichloromonofluoromethane	<1.0

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA Method 502.2.

*Present but less than the practical quantitation limit.

COMPLETE ENVIRONMENTAL ANALYTICAL SERVICE

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Randy Huffsmith
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-15040 dup
DATE: 06/18/90 dya

QUALITY ASSURANCE - DUPLICATE ANALYSIS

Helena City Landfill
HL-9006-102
Sampled 06/05/90 @ 1100
Submitted 06/07/90

#36 Duplicate (LAB)

<u>Volatile Organic Constituent</u>	<u>µg/l</u>	<u>Volatile Organic Constituent</u>	<u>µg/l</u>
Dichlorodifluoromethane	<1.0	1,1,1,2-Tetrachloroethane	<1.0
Chloromethane	<1.0	Ethylbenzene	<1.0
Vinyl chloride	<0.50	p-Xylene	<1.0
Bromomethane	<1.0	m-Xylene	<1.0
Chloroethane	<1.0	o-Xylene	<1.0
Trichlorofluoromethane	<1.0	Styrene	<1.0
1,1-Dichloroethene	<0.50	Bromoform	<1.0
Methylene Chloride	<1.0	Isopropylbenzene	<1.0
trans-1,2-Dichloroethene	<1.0	1,1,2,2-Tetrachloroethane	<1.0
1,1-Dichloroethane	<1.0	Bromobenzene	<1.0
2,2-Dichloropropane	<1.0	1,2,3-Trichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0	n-Propylbenzene	<1.0
Chloroform	<1.0	2-Chlorotoluene	<1.0
Bromochloromethane	<1.0	1,3,5-Trimethylbenzene	<1.0
1,1,1-Trichloroethane	<0.50	4-Chlorotoluene	<1.0
Carbon Tetrachloride	<0.50	tert-Butylbenzene	<1.0
1,1-Dichloropropene	<1.0	1,2,4-Trimethylbenzene	<1.0
Benzene	<0.50	sec-Butylbenzene	<1.0
1,2-Dichloroethane	<0.50	p-Isopropyltoluene	<1.0
Trichloroethene	<0.50	1,3-Dichlorobenzene	<1.0
1,2-Dichloropropane	<1.0	1,4-Dichlorobenzene	<0.50
Bromodichloromethane	<1.0	n-Butylbenzene	<1.0
Dibromomethane	<1.0	1,2-Dichlorobenzene	<1.0
Toluene	<1.0	1,2-Dibromo-3-Chloropropane	<1.0
1,1,2-Trichloroethane	<1.0	1,2,4-Trichlorobenzene	<1.0
Tetrachloroethene	<0.50	Hexachlorobutadiene	<1.0
1,3-Dichloropropane	<1.0	Naphthalene	<1.0
Dibromochloromethane	<1.0	1,2,3-Trichlorobenzene	<1.0
1,2-Dibromoethane	<1.0	cis-1,3-Dichloropropene	<1.0
Chlorobenzene	<1.0	trans-1,3-Dichloropropene	<1.0
		Dichloromonofluoromethane	<1.0

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA Method 502.2.

*Present but less than the practical quantitation limit.

COMPLETE ENVIRONMENTAL ANALYTICAL SERVICE

LABORATORY REPORT

LAS NO.: 80-18042 dup
DATE: 06/16/90 cys

TO: HYDROCARBONS
FROM: RALPH W. JENNIFER
2727 ALISON ROAD
HARRIS, MT 29801

QUALITY ASSURANCE - DUPLICATE ANALYSIS

Harris City Landfill
HL-8009-102
Sampled 06/05/90 @ 1100
Submitted 06/16/90
#250 B-P-C-102 (LAS)

NAME	CONC	NAME	CONC	NAME	CONC
Chlorobenzene	<1.0	Chlorobenzene	<1.0	Chlorobenzene	<1.0
Bromobenzene	<1.0	Bromobenzene	<1.0	Bromobenzene	<1.0
Phenyl Acetylene	<1.0	Phenyl Acetylene	<1.0	Phenyl Acetylene	<1.0
Styrene	<1.0	Styrene	<1.0	Styrene	<1.0
o-Xylene	<1.0	o-Xylene	<1.0	o-Xylene	<1.0
m-Xylene	<1.0	m-Xylene	<1.0	m-Xylene	<1.0
p-Xylene	<1.0	p-Xylene	<1.0	p-Xylene	<1.0
Ethylbenzene	<1.0	Ethylbenzene	<1.0	Ethylbenzene	<1.0
1,1,1-Trichloroethane	<1.0	1,1,1-Trichloroethane	<1.0	1,1,1-Trichloroethane	<1.0
1,1,2-Trichloroethane	<1.0	1,1,2-Trichloroethane	<1.0	1,1,2-Trichloroethane	<1.0
1,1,2,2-Tetrachloroethane	<1.0	1,1,2,2-Tetrachloroethane	<1.0	1,1,2,2-Tetrachloroethane	<1.0
1,1,1,1-Tetrachloroethane	<1.0	1,1,1,1-Tetrachloroethane	<1.0	1,1,1,1-Tetrachloroethane	<1.0
1,1,1,2-Tetrachloroethane	<1.0	1,1,1,2-Tetrachloroethane	<1.0	1,1,1,2-Tetrachloroethane	<1.0
1,1,2,2,3-Pentachloropropane	<1.0	1,1,2,2,3-Pentachloropropane	<1.0	1,1,2,2,3-Pentachloropropane	<1.0
1,1,2,2,3,3-Hexachloropropane	<1.0	1,1,2,2,3,3-Hexachloropropane	<1.0	1,1,2,2,3,3-Hexachloropropane	<1.0
1,1,1,2,2-Pentachloropropane	<1.0	1,1,1,2,2-Pentachloropropane	<1.0	1,1,1,2,2-Pentachloropropane	<1.0
1,1,1,2,3-Pentachloropropane	<1.0	1,1,1,2,3-Pentachloropropane	<1.0	1,1,1,2,3-Pentachloropropane	<1.0
1,1,1,3,3-Pentachloropropane	<1.0	1,1,1,3,3-Pentachloropropane	<1.0	1,1,1,3,3-Pentachloropropane	<1.0
1,1,2,3,3-Pentachloropropane	<1.0	1,1,2,3,3-Pentachloropropane	<1.0	1,1,2,3,3-Pentachloropropane	<1.0
1,1,2,3,4-Pentachloropropane	<1.0	1,1,2,3,4-Pentachloropropane	<1.0	1,1,2,3,4-Pentachloropropane	<1.0
1,1,2,3,5-Pentachloropropane	<1.0	1,1,2,3,5-Pentachloropropane	<1.0	1,1,2,3,5-Pentachloropropane	<1.0
1,1,2,4,4-Pentachloropropane	<1.0	1,1,2,4,4-Pentachloropropane	<1.0	1,1,2,4,4-Pentachloropropane	<1.0
1,1,2,4,5-Pentachloropropane	<1.0	1,1,2,4,5-Pentachloropropane	<1.0	1,1,2,4,5-Pentachloropropane	<1.0
1,1,2,5,5-Pentachloropropane	<1.0	1,1,2,5,5-Pentachloropropane	<1.0	1,1,2,5,5-Pentachloropropane	<1.0
1,1,3,3,3-Pentachloropropane	<1.0	1,1,3,3,3-Pentachloropropane	<1.0	1,1,3,3,3-Pentachloropropane	<1.0
1,1,3,3,4-Pentachloropropane	<1.0	1,1,3,3,4-Pentachloropropane	<1.0	1,1,3,3,4-Pentachloropropane	<1.0
1,1,3,3,5-Pentachloropropane	<1.0	1,1,3,3,5-Pentachloropropane	<1.0	1,1,3,3,5-Pentachloropropane	<1.0
1,1,3,4,4-Pentachloropropane	<1.0	1,1,3,4,4-Pentachloropropane	<1.0	1,1,3,4,4-Pentachloropropane	<1.0
1,1,3,4,5-Pentachloropropane	<1.0	1,1,3,4,5-Pentachloropropane	<1.0	1,1,3,4,5-Pentachloropropane	<1.0
1,1,3,5,5-Pentachloropropane	<1.0	1,1,3,5,5-Pentachloropropane	<1.0	1,1,3,5,5-Pentachloropropane	<1.0
1,1,4,4,4-Pentachloropropane	<1.0	1,1,4,4,4-Pentachloropropane	<1.0	1,1,4,4,4-Pentachloropropane	<1.0
1,1,4,4,5-Pentachloropropane	<1.0	1,1,4,4,5-Pentachloropropane	<1.0	1,1,4,4,5-Pentachloropropane	<1.0
1,1,4,5,5-Pentachloropropane	<1.0	1,1,4,5,5-Pentachloropropane	<1.0	1,1,4,5,5-Pentachloropropane	<1.0
1,1,5,5,5-Pentachloropropane	<1.0	1,1,5,5,5-Pentachloropropane	<1.0	1,1,5,5,5-Pentachloropropane	<1.0
1,2,2,3,3-Pentachloropropane	<1.0	1,2,2,3,3-Pentachloropropane	<1.0	1,2,2,3,3-Pentachloropropane	<1.0
1,2,2,3,4-Pentachloropropane	<1.0	1,2,2,3,4-Pentachloropropane	<1.0	1,2,2,3,4-Pentachloropropane	<1.0
1,2,2,3,5-Pentachloropropane	<1.0	1,2,2,3,5-Pentachloropropane	<1.0	1,2,2,3,5-Pentachloropropane	<1.0
1,2,2,4,4-Pentachloropropane	<1.0	1,2,2,4,4-Pentachloropropane	<1.0	1,2,2,4,4-Pentachloropropane	<1.0
1,2,2,4,5-Pentachloropropane	<1.0	1,2,2,4,5-Pentachloropropane	<1.0	1,2,2,4,5-Pentachloropropane	<1.0
1,2,2,5,5-Pentachloropropane	<1.0	1,2,2,5,5-Pentachloropropane	<1.0	1,2,2,5,5-Pentachloropropane	<1.0
1,2,3,3,3-Pentachloropropane	<1.0	1,2,3,3,3-Pentachloropropane	<1.0	1,2,3,3,3-Pentachloropropane	<1.0
1,2,3,3,4-Pentachloropropane	<1.0	1,2,3,3,4-Pentachloropropane	<1.0	1,2,3,3,4-Pentachloropropane	<1.0
1,2,3,3,5-Pentachloropropane	<1.0	1,2,3,3,5-Pentachloropropane	<1.0	1,2,3,3,5-Pentachloropropane	<1.0
1,2,3,4,4-Pentachloropropane	<1.0	1,2,3,4,4-Pentachloropropane	<1.0	1,2,3,4,4-Pentachloropropane	<1.0
1,2,3,4,5-Pentachloropropane	<1.0	1,2,3,4,5-Pentachloropropane	<1.0	1,2,3,4,5-Pentachloropropane	<1.0
1,2,3,5,5-Pentachloropropane	<1.0	1,2,3,5,5-Pentachloropropane	<1.0	1,2,3,5,5-Pentachloropropane	<1.0
1,2,4,4,4-Pentachloropropane	<1.0	1,2,4,4,4-Pentachloropropane	<1.0	1,2,4,4,4-Pentachloropropane	<1.0
1,2,4,4,5-Pentachloropropane	<1.0	1,2,4,4,5-Pentachloropropane	<1.0	1,2,4,4,5-Pentachloropropane	<1.0
1,2,4,5,5-Pentachloropropane	<1.0	1,2,4,5,5-Pentachloropropane	<1.0	1,2,4,5,5-Pentachloropropane	<1.0
1,2,5,5,5-Pentachloropropane	<1.0	1,2,5,5,5-Pentachloropropane	<1.0	1,2,5,5,5-Pentachloropropane	<1.0
1,3,3,3,3-Pentachloropropane	<1.0	1,3,3,3,3-Pentachloropropane	<1.0	1,3,3,3,3-Pentachloropropane	<1.0
1,3,3,3,4-Pentachloropropane	<1.0	1,3,3,3,4-Pentachloropropane	<1.0	1,3,3,3,4-Pentachloropropane	<1.0
1,3,3,3,5-Pentachloropropane	<1.0	1,3,3,3,5-Pentachloropropane	<1.0	1,3,3,3,5-Pentachloropropane	<1.0
1,3,3,4,4-Pentachloropropane	<1.0	1,3,3,4,4-Pentachloropropane	<1.0	1,3,3,4,4-Pentachloropropane	<1.0
1,3,3,4,5-Pentachloropropane	<1.0	1,3,3,4,5-Pentachloropropane	<1.0	1,3,3,4,5-Pentachloropropane	<1.0
1,3,3,5,5-Pentachloropropane	<1.0	1,3,3,5,5-Pentachloropropane	<1.0	1,3,3,5,5-Pentachloropropane	<1.0
1,3,4,4,4-Pentachloropropane	<1.0	1,3,4,4,4-Pentachloropropane	<1.0	1,3,4,4,4-Pentachloropropane	<1.0
1,3,4,4,5-Pentachloropropane	<1.0	1,3,4,4,5-Pentachloropropane	<1.0	1,3,4,4,5-Pentachloropropane	<1.0
1,3,4,5,5-Pentachloropropane	<1.0	1,3,4,5,5-Pentachloropropane	<1.0	1,3,4,5,5-Pentachloropropane	<1.0
1,3,5,5,5-Pentachloropropane	<1.0	1,3,5,5,5-Pentachloropropane	<1.0	1,3,5,5,5-Pentachloropropane	<1.0
1,4,4,4,4-Pentachloropropane	<1.0	1,4,4,4,4-Pentachloropropane	<1.0	1,4,4,4,4-Pentachloropropane	<1.0
1,4,4,4,5-Pentachloropropane	<1.0	1,4,4,4,5-Pentachloropropane	<1.0	1,4,4,4,5-Pentachloropropane	<1.0
1,4,4,5,5-Pentachloropropane	<1.0	1,4,4,5,5-Pentachloropropane	<1.0	1,4,4,5,5-Pentachloropropane	<1.0
1,4,5,5,5-Pentachloropropane	<1.0	1,4,5,5,5-Pentachloropropane	<1.0	1,4,5,5,5-Pentachloropropane	<1.0
1,5,5,5,5-Pentachloropropane	<1.0	1,5,5,5,5-Pentachloropropane	<1.0	1,5,5,5,5-Pentachloropropane	<1.0

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed according with EPA Method 801.5.

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Steve Downs
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-10821
DATE: 05/23/90 dya

WATER ANALYSIS

Helena Landfill

HL-9005-104

Sampled 05/03/90 @ 1310

Submitted 05/08/90

#38

<u>Volatile Organic Constituent</u>	<u>µg/l</u>	<u>Volatile Organic Constituent</u>	<u>µg/l</u>
Dichlorodifluoromethane	<1.0*	1,1,1,2-Tetrachloroethane	<1.0
Chloromethane	<1.0	Ethylbenzene	<1.0
Vinyl chloride	<0.50	p-Xylene	<1.0
Bromomethane	<1.0	m-Xylene	<1.0
Chloroethane	<1.0	o-Xylene	<1.0
Trichlorofluoromethane	<1.0	Styrene	<1.0
1,1-Dichloroethene	<0.50	Bromoform	<1.0
Methylene Chloride	<1.0	Isopropylbenzene	<1.0
trans-1,2-Dichloroethene	<1.0	1,1,2,2-Tetrachloroethane	<1.0
1,1-Dichloroethane	<1.0	Bromobenzene	<1.0
2,2-Dichloropropane	<1.0	1,2,3-Trichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0	n-Propylbenzene	<1.0
Chloroform	9.0	2-Chlorotoluene	<1.0
Bromochloromethane	<1.0	1,3,5-Trimethylbenzene	<1.0
1,1,1-Trichloroethane	<0.50*	4-Chlorotoluene	<1.0
Carbon Tetrachloride	<0.50	tert-Butylbenzene	<1.0
1,1-Dichloropropene	<1.0	1,2,4-Trimethylbenzene	<1.0
Benzene	<0.50	sec-Butylbenzene	<1.0
1,2-Dichloroethane	<0.50	p-Isopropyltoluene	<1.0
Trichloroethene	<0.50	1,3-Dichlorobenzene	<1.0
1,2-Dichloropropane	<1.0	1,4-Dichlorobenzene	<0.50
Bromodichloromethane	<1.0*	n-Butylbenzene	<1.0
Dibromomethane	<1.0	1,2-Dichlorobenzene	<1.0
Toluene	<1.0	1,2-Dibromo-3-Chloropropane	<1.0
1,1,2-Trichloroethane	<1.0	1,2,4-Trichlorobenzene	<1.0
Tetrachloroethene	1.1	Hexachlorobutadiene	<1.0
1,3-Dichloropropane	<1.0	Naphthalene	<1.0
Dibromochloromethane	<1.0	1,2,3-Trichlorobenzene	<1.0
1,2-Dibromoethane	<1.0	cis-1,3-Dichloropropene	<1.0
Chlorobenzene	<1.0	trans-1,3-Dichloropropene	<1.0
		Dichloromonofluoromethane	<1.0*

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA Method 502.2

*Present but less than the practical quantitation limit.

COMPLETE ENVIRONMENTAL ANALYTICAL SERVICE

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Steve Downs
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-10833
DATE: 05/23/90 dya

WATER ANALYSIS

Helena Landfill

HL-9005-204

Sampled 05/03/90 @ 1340

Submitted 05/08/90

Dup #38

<u>Volatile Organic Constituent</u>	<u>µg/l</u>	<u>Volatile Organic Constituent</u>	<u>µg/l</u>
Dichlorodifluoromethane	1.0	1,1,1,2-Tetrachloroethane	<1.0
Chloromethane	<1.0	Ethylbenzene	<1.0
Vinyl chloride	<0.50	p-Xylene	<1.0
Bromomethane	<1.0	m-Xylene	<1.0
Chloroethane	<1.0	o-Xylene	<1.0
Trichlorofluoromethane	<1.0	Styrene	<1.0
1,1-Dichloroethene	<0.50	Bromoform	<1.0
Methylene Chloride	<1.0	Isopropylbenzene	<1.0
trans-1,2-Dichloroethene	<1.0	1,1,2,2-Tetrachloroethane	<1.0
1,1-Dichloroethane	<1.0	Bromobenzene	<1.0
2,2-Dichloropropane	<1.0	1,2,3-Trichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0	n-Propylbenzene	<1.0
Chloroform	7.9	2-Chlorotoluene	<1.0
Bromochloromethane	<1.0	1,3,5-Trimethylbenzene	<1.0
1,1,1-Trichloroethane	<0.50*	4-Chlorotoluene	<1.0
Carbon Tetrachloride	<0.50	tert-Butylbenzene	<1.0
1,1-Dichloropropene	<1.0	1,2,4-Trimethylbenzene	<1.0
Benzene	<0.50	sec-Butylbenzene	<1.0
1,2-Dichloroethane	<0.50	p-Isopropyltoluene	<1.0
Trichloroethene	<0.50	1,3-Dichlorobenzene	<1.0
1,2-Dichloropropane	<1.0	1,4-Dichlorobenzene	<0.50
Bromodichloromethane	<1.0*	n-Butylbenzene	<1.0
Dibromomethane	<1.0	1,2-Dichlorobenzene	<1.0
Toluene	<1.0	1,2-Dibromo-3-Chloropropane	<1.0
1,1,2-Trichloroethane	<1.0	1,2,4-Trichlorobenzene	<1.0
Tetrachloroethene	0.97	Hexachlorobutadiene	<1.0
1,3-Dichloropropane	<1.0	Naphthalene	<1.0
Dibromochloromethane	<1.0	1,2,3-Trichlorobenzene	<1.0
1,2-Dibromoethane	<1.0	cis-1,3-Dichloropropene	<1.0
Chlorobenzene	<1.0	trans-1,3-Dichloropropene	<1.0
		Dichloromonofluoromethane	<1.0*

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA Method 502.2

*Present but less than the practical quantitation limit.

COMPLETE ENVIRONMENTAL ANALYTICAL SERVICE

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Steve Downs
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-10833
DATE: 05/23/90 dya

WATER ANALYSIS

Helena Landfill
HL-9005-204
Sampled 05/03/90 @ 1340
Submitted 05/08/90

Dup #38

<u>Volatile Organic Constituent</u>	<u>µg/l</u>	<u>Volatile Organic Constituent</u>	<u>µg/l</u>
Dichlorodifluoromethane	1.0	1,1,1,2-Tetrachloroethane	<1.0
Chloromethane	<1.0	Ethylbenzene	<1.0
Vinyl chloride	<0.50	p-Xylene	<1.0
Bromomethane	<1.0	m-Xylene	<1.0
Chloroethane	<1.0	o-Xylene	<1.0
Trichlorofluoromethane	<1.0	Styrene	<1.0
1,1-Dichloroethene	<0.50	Bromoform	<1.0
Methylene Chloride	<1.0	Isopropylbenzene	<1.0
trans-1,2-Dichloroethene	<1.0	1,1,2,2-Tetrachloroethane	<1.0
1,1-Dichloroethane	<1.0	Bromobenzene	<1.0
2,2-Dichloropropane	<1.0	1,2,3-Trichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0	n-Propylbenzene	<1.0
Chloroform	7.9	2-Chlorotoluene	<1.0
Bromochloromethane	<1.0	1,3,5-Trimethylbenzene	<1.0
1,1,1-Trichloroethane	<0.50*	4-Chlorotoluene	<1.0
Carbon Tetrachloride	<0.50	tert-Butylbenzene	<1.0
1,1-Dichloropropene	<1.0	1,2,4-Trimethylbenzene	<1.0
Benzene	<0.50	sec-Butylbenzene	<1.0
1,2-Dichloroethane	<0.50	p-Isopropyltoluene	<1.0
Trichloroethene	<0.50	1,3-Dichlorobenzene	<1.0
1,2-Dichloropropane	<1.0	1,4-Dichlorobenzene	<0.50
Bromodichloromethane	<1.0*	n-Butylbenzene	<1.0
Dibromomethane	<1.0	1,2-Dichlorobenzene	<1.0
Toluene	<1.0	1,2-Dibromo-3-Chloropropane	<1.0
1,1,2-Trichloroethane	<1.0	1,2,4-Trichlorobenzene	<1.0
Tetrachloroethene	0.97	Hexachlorobutadiene	<1.0
1,3-Dichloropropane	<1.0	Naphthalene	<1.0
Dibromochloromethane	<1.0	1,2,3-Trichlorobenzene	<1.0
1,2-Dibromoethane	<1.0	cis-1,3-Dichloropropene	<1.0
Chlorobenzene	<1.0	trans-1,3-Dichloropropene	<1.0
		Dichloromonofluoromethane	<1.0*

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA Method 502.2

*Present but less than the practical quantitation limit.

COMPLETE ENVIRONMENTAL ANALYTICAL SERVICE

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Steve Downs
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-10831
DATE: 05/23/90 dya

WATER ANALYSIS

Helena Landfill

HL-9005-114

Sampled 05/06/90 @ 1215

Submitted 05/08/90

40

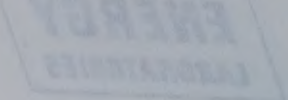
<u>Volatile Organic Constituent</u>	<u>µg/l</u>
Dichlorodifluoromethane	4.5
Chloromethane	<1.0
Vinyl chloride	<0.50
Bromomethane	<1.0
Chloroethane	<1.0
Trichlorofluoromethane	<1.0*
1,1-Dichloroethene	<0.50*
Methylene Chloride	1.0
trans-1,2-Dichloroethene	<1.0
1,1-Dichloroethane	1.5
2,2-Dichloropropane	<1.0
cis-1,2-Dichloroethene	2.0
Chloroform	11.0
Bromochloromethane	<1.0
1,1,1-Trichloroethane	1.3
Carbon Tetrachloride	<0.50
1,1-Dichloropropene	<1.0
Benzene	<0.50
1,2-Dichloroethane	<0.50
Trichloroethene	1.3
1,2-Dichloropropane	<1.0
Bromodichloromethane	<1.0*
Dibromomethane	<1.0
Toluene	<1.0
1,1,2-Trichloroethane	<1.0
Tetrachloroethene	8.0
1,3-Dichloropropane	<1.0
Dibromochloromethane	<1.0
1,2-Dibromoethane	<1.0
Chlorobenzene	<1.0

<u>Volatile Organic Constituent</u>	<u>µg/l</u>
1,1,1,2-Tetrachloroethane	<1.0
Ethylbenzene	<1.0
p-Xylene	<1.0
m-Xylene	<1.0
o-Xylene	<1.0
Styrene	<1.0
Bromoform	<1.0
Isopropylbenzene	<1.0
1,1,2,2-Tetrachloroethane	<1.0
Bromobenzene	<1.0
1,2,3-Trichloropropane	<1.0
n-Propylbenzene	<1.0
2-Chlorotoluene	<1.0
1,3,5-Trimethylbenzene	<1.0
4-Chlorotoluene	<1.0
tert-Butylbenzene	<1.0
1,2,4-Trimethylbenzene	<1.0
sec-Butylbenzene	<1.0
p-Isopropyltoluene	<1.0
1,3-Dichlorobenzene	<1.0
1,4-Dichlorobenzene	<0.50
n-Butylbenzene	<1.0
1,2-Dichlorobenzene	<1.0
1,2-Dibromo-3-Chloropropane	<1.0
1,2,4-Trichlorobenzene	<1.0
Hexachlorobutadiene	<1.0
Naphthalene	<1.0
1,2,3-Trichlorobenzene	<1.0
cis-1,3-Dichloropropene	<1.0
trans-1,3-Dichloropropene	<1.0
Dichloromonofluoromethane	4.1

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA Method 502.2

*Present but less than the practical quantitation limit.

COMPLETE ENVIRONMENTAL ANALYTICAL SERVICE



ENERGY LABORATORIES, INC.
102 ROCK SPRING • 1107 SOUTH BRADWAY • BRIDGEVIEW, WY 82801 • PHONE (408) 282-0222
FAX (408) 282-0222 • 1-800-457-4527

LABORATORY REPORT

LAB NO.: 8040821
DATE: 02/22/90 dya

TO:
ADDRESS:
2327 Airport Road
Hyland, MT 59501

WATER ANALYSIS
Hyland Landfill
HL-8005-114
Sampled 02/09/90 @ 1215
Submitted 02/09/90

15

Volatile Organic Compounds	mg/l	Volatile Organic Compounds	mg/l
1,1,1,2-Tetrachloroethane	<1.0	Chloroacetaldehyde	<1.0
Benzene	<1.0	Chloroform	<1.0
p-Xylene	<1.0	1,1-Dichloroethane	<1.0
m-Xylene	<1.0	Methylene Chloride	<1.0
o-Xylene	<1.0	trans-1,2-Dichloroethane	<1.0
Styrene	<1.0	1,1-Dichloroethene	<1.0
Bromobenzene	<1.0	trans-1,2-Dichloroethene	<1.0
Isopropylbenzene	<1.0	1,2-Dichlorobenzene	<1.0
1,1,2,2-Tetrachloroethane	<1.0	2,3-Dichloropropene	<1.0
Bromobenzene	<1.0	cis-1,2-Dichloroethane	<1.0
1,2,3-Trichloropropane	<1.0	Chlorobenzene	<1.0
n-Propylbenzene	<1.0	Bromochloroethane	<1.0
2-Chlorobenzene	<1.0	1,1,1-Trichloroethane	<1.0
1,2,4-Trimethylbenzene	<1.0	Carbon Tetrachloride	<1.0
4-Chlorobenzene	<1.0	1,1-Dichloroethene	<1.0
tert-Butylbenzene	<1.0	Benzene	<1.0
1,2,4-Trimethylbenzene	<1.0	1,2-Dichlorobenzene	<1.0
sec-Butylbenzene	<1.0	1,3-Dichlorobenzene	<1.0
n-Propylbenzene	<1.0	1,4-Dichlorobenzene	<1.0
1,3-Dichlorobenzene	<1.0	n-Butylbenzene	<1.0
1,4-Dichlorobenzene	<1.0	1,2-Dichloroethane	<1.0
n-Butylbenzene	<1.0	1,2,4-Trichlorobenzene	<1.0
1,2-Dichloroethane	<1.0	Hexachlorobutadiene	<1.0
1,2,4-Trichlorobenzene	<1.0	Naphthalene	<1.0
Hexachlorobutadiene	<1.0	1,2,3-Trichlorobenzene	<1.0
Naphthalene	<1.0	cis-1,2-Dichloroethene	<1.0
1,2,3-Trichlorobenzene	<1.0	trans-1,2-Dichloroethene	<1.0
cis-1,2-Dichloroethene	<1.0	Dichlorodifluoromethane	<1.0
trans-1,2-Dichloroethene	<1.0		

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed according to EPA Method 802.2.
*Present but less than the practical quantitation limit.
COMPLETE ENVIRONMENTAL ANALYTICAL SERVICE

ENERGY LABORATORIES

ENERGY LABORATORIES, INC.

P.O. BOX 30916 • 1107 SOUTH BROADWAY • BILLINGS, MT 59107-0916 • PHONE (406) 252-6325
FAX (406) 252-6069 • 1-800-873-5227

LABORATORY REPORT

PAGE : 1

To : Hydrometrics
Address : Attn: Steve Downs
2727 Airport Road
Helena, MT 59061

Lab No. : 91-13086
Date : 6/14/91

WATER ANALYSIS REPORT

Sample Pt Name : HL9104-109
Sample Date : 4/13/91
Sample Time : 13:40:00
Sample Received : 4/16/91
Helena Landfill
Revised 06/14/91

JUN 17

LABORATORY DATA:

Acetone-----	(ug/l)----	<10
Acrolein-----	(ug/l)----	<10
Acrylonitrile-----	(ug/l)----	<10
Benzene-----	(ug/l)----	<0.50
Bromochloromethane-----	(ug/l)----	<1.0
Bromodichloromethane-----	(ug/l)----	<1.0*
1,3-Dichloropropene-----	(ug/l)----	<1.0
trans-1,3-Dichloropropene-----	(ug/l)----	<1.0
1,4-Difluorobenzene-----	(mg/l)----	<10
Ethanol-----	(ug/l)----	<1.0
Ethylbenzene-----	(ug/l)----	<10
Ethyl methacrylate-----	(ug/l)----	<10
4-Bromofluorobenzene-----	(ug/l)----	<1.0
Bromoform-----	(ug/l)----	<1.0
Bromomethane-----	(ug/l)----	<10
2-Butanone(Methyl Ethyl Ketone)-----	(ug/l)----	<10
Carbon disulfide-----	(ug/l)----	<0.50
Carbon Tetrachloride-----	(ug/l)----	<1.0
Chlorobenzene-----	(ug/l)----	<1.0
Dibromochloromethane-----	(ug/l)----	<1.0
Chloroethane-----	(ug/l)----	<10
2-Chloroethylvinyl ether-----	(ug/l)----	11
Chloroform-----	(ug/l)----	<1.0
Chloromethane-----	(ug/l)----	<1.0
Dibromomethane-----	(ug/l)----	<10
1,4-Dichloro-2-butene-----	(ug/l)----	2.1
Dichlorodifluoromethane-----	(ug/l)----	1.2
1,1-Dichloroethane-----	(ug/l)----	<0.50
1,2-Dichloroethane-----	(ug/l)----	<10
2-Hexanone-----	(ug/l)----	<10
Iodomethane-----	(ug/l)----	<1.0*
Methylene Chloride-----	(ug/l)----	<10
Methyl-2-pentanone-----	(ug/l)----	<0.50
trans-1,2-Dichloroethene-----	(ug/l)----	<1.0
Styrene-----	(ug/l)----	<1.0

**ENERGY
LABORATORIES**
ENERGY LABORATORIES, INC.

 P.O. BOX 30916 • 1107 SOUTH BROADWAY • BILLINGS, MT 59107-0916 • PHONE (406) 252-6325
 FAX (406) 252-6069 • 1-800-873-5227

LABORATORY REPORT

PAGE : 2

 To : Hydrometrics
 Address : Attn: Steve Downs
2727 Airport Road
Helena, MT 59061

 Lab No. : 91-13086
 Date : 6/14/91
WATER ANALYSIS REPORT

 Sample Pt Name : HL9104-109
 Sample Date : 4/13/91
 Sample Time : 13:40:00
 Sample Received : 4/16/91
Helena Landfill
 Revised 06/14/91
LABORATORY DATA:

1,1,2,2-Tetrachloroethane-----	(ug/l)----	<1.0
Tetrachloroethene-----	(ug/l)----	5.6
Toluene-----	(ug/l)----	<1.0
1,1,1-Trichloroethane-----	(ug/l)----	1.0
1,1,2-Trichloroethane-----	(ug/l)----	<1.0
Trichloroethene-----	(ug/l)----	0.88
Chlorofluoromethane-----	(ug/l)----	<1.0*
1,3-Trichloropropane-----	(ug/l)----	<1.0
vinyl acetate-----	(ug/l)----	<10
vinyl chloride-----	(ug/l)----	<0.50
Xylenes-----	(ug/l)----	<1.0

 *Present but less than the practical quantitation limits.
 CC:

LABORATORY REPORT

PAGE : 1

Lab No. : 91-1108
Date : 8/1/91

Hydrocarbons
Total Gaseous Hydrocarbons
Total Aromatic Hydrocarbons
Total Petroleum Hydrocarbons

WATER ANALYSIS REPORT

Sample ID Name : MS104-100
Sample Date : 4/13/91
Sample Time : 11:40:00
Sample Received : 4/18/91
Helena Landfill
Revised 06/14/91

<1.0
0.5
<1.0
1.0
<1.0
0.38
<1.0
<1.0
<1.0
<1.0
<0.50
<1.0

(ug/l)
(ug/l)
(ug/l)
(ug/l)
(ug/l)
(ug/l)
(ug/l)
(ug/l)
(ug/l)
(ug/l)
(ug/l)
(ug/l)

*Present but less than the practical quantitation limits.

LABORATORY REPORTTO: Hydrometrics
ADDRESS: Steve Downs
2727 Airport Road
Helena, MT 59601LAB NO.: 90-10819
DATE: 05/23/90 dyaWATER ANALYSISHelena Landfill
HL-9005-102Sampled 05/03/90 @ 1220
Submitted 05/08/90

#42

<u>Volatile Organic Constituent</u>	<u>µg/l</u>	<u>Volatile Organic Constituent</u>	<u>µg/l</u>
Dichlorodifluoromethane	4.6	1,1,1,2-Tetrachloroethane	<1.0
Chloromethane	<1.0	Ethylbenzene	<1.0
Vinyl chloride	<0.50	p-Xylene	<1.0
Bromomethane	<1.0	m-Xylene	<1.0
Chloroethane	<1.0	o-Xylene	<1.0
Trichlorofluoromethane	<1.0*	Styrene	<1.0
1,1-Dichloroethene	<0.50	Bromoform	<1.0
Methylene Chloride	<1.0*	Isopropylbenzene	<1.0
trans-1,2-Dichloroethene	<1.0	1,1,2,2-Tetrachloroethane	<1.0
1,1-Dichloroethane	<1.0*	Bromobenzene	<1.0
2,2-Dichloropropane	<1.0	1,2,3-Trichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0*	n-Propylbenzene	<1.0
Chloroform	2.8	2-Chlorotoluene	<1.0
Bromochloromethane	<1.0	1,3,5-Trimethylbenzene	<1.0
1,1,1-Trichloroethane	0.89	4-Chlorotoluene	<1.0
Carbon Tetrachloride	<0.50	tert-Butylbenzene	<1.0
1,1-Dichloropropene	<1.0	1,2,4-Trimethylbenzene	<1.0
Benzene	<0.50	sec-Butylbenzene	<1.0
1,2-Dichloroethane	<0.50	p-Isopropyltoluene	<1.0
Trichloroethene	0.50	1,3-Dichlorobenzene	<1.0
1,2-Dichloropropane	<1.0	1,4-Dichlorobenzene	<0.50
Bromodichloromethane	<1.0	n-Butylbenzene	<1.0
Dibromomethane	<1.0	1,2-Dichlorobenzene	<1.0
Toluene	<1.0	1,2-Dibromo-3-Chloropropane	<1.0
1,1,2-Trichloroethane	<1.0	1,2,4-Trichlorobenzene	<1.0
Tetrachloroethene	5.0	Hexachlorobutadiene	<1.0
1,3-Dichloropropane	<1.0	Naphthalene	<1.0
Dibromochloromethane	<1.0	1,2,3-Trichlorobenzene	<1.0
1,2-Dibromoethane	<1.0	cis-1,3-Dichloropropene	<1.0
Chlorobenzene	<1.0	trans-1,3-Dichloropropene	<1.0
		Dichloromonofluoromethane	2.4

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA Method 502.2

*Present but less than the practical quantitation limit.

COMPLETE ENVIRONMENTAL ANALYTICAL SERVICE

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Bill Peery
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-14925
DATE: 06/18/90 dya

WATER ANALYSIS

Helena Landfill

HL-0690-200

Sampled 06/01/90 @ 1330

Submitted 06/05/90

48

Volatile Organic Constituent

	<u>µg/l</u>
Dichlorodifluoromethane	1.0
Chloromethane	<1.0
Vinyl chloride	<0.50
Bromomethane	<1.0
Chloroethane	<1.0
Trichlorofluoromethane	<1.0*
1,1-Dichloroethene	<0.50
Methylene Chloride	<1.0
trans-1,2-Dichloroethene	<1.0
1,1-Dichloroethane	<1.0*
2,2-Dichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0
Chloroform	1.6
Bromochloromethane	<1.0
1,1,1-Trichloroethane	0.67
Carbon Tetrachloride	<0.50
1,1-Dichloropropene	<1.0
Benzene	<0.50
1,2-Dichloroethane	<0.50
Trichloroethene	<0.50*
1,2-Dichloropropane	<1.0
Bromodichloromethane	<1.0
Dibromomethane	<1.0
Toluene	<1.0
1,1,2-Trichloroethane	<1.0
Tetrachloroethene	1.7
1,3-Dichloropropane	<1.0
Dibromochloromethane	<1.0
1,2-Dibromoethane	<1.0
Chlorobenzene	<1.0

Volatile Organic Constituent

	<u>µg/l</u>
1,1,1,2-Tetrachloroethane	<1.0
Ethylbenzene	<1.0
p-Xylene	<1.0
m-Xylene	<1.0
o-Xylene	<1.0
Styrene	<1.0
Bromoform	<1.0
Isopropylbenzene	<1.0
1,1,2,2-Tetrachloroethane	<1.0
Bromobenzene	<1.0
1,2,3-Trichloropropane	<1.0
n-Propylbenzene	<1.0
2-Chlorotoluene	<1.0
1,3,5-Trimethylbenzene	<1.0
4-Chlorotoluene	<1.0
tert-Butylbenzene	<1.0
1,2,4-Trimethylbenzene	<1.0
sec-Butylbenzene	<1.0
p-Isopropyltoluene	<1.0
1,3-Dichlorobenzene	<1.0
1,4-Dichlorobenzene	<0.50
n-Butylbenzene	<1.0
1,2-Dichlorobenzene	<1.0
1,2-Dibromo-3-Chloropropane	<1.0
1,2,4-Trichlorobenzene	<1.0
Hexachlorobutadiene	<1.0
Naphthalene	<1.0
1,2,3-Trichlorobenzene	<1.0
cis-1,3-Dichloropropene	<1.0
trans-1,3-Dichloropropene	<1.0
Dichloromonofluoromethane	<1.0*

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA Method 502.2.

*Present but less than the practical quantitation limit.

COMPLETE ENVIRONMENTAL ANALYTICAL SERVICE

LABORATORY REPORT

LAB NO.: 60-14828
DATE: 06/16/90

TO: Hydroneutics
ADDRESS: 2127 Airport Road
Helena, MT 59601

WATER ANALYSIS

Helena Landfill

HL-0690-200

Sampled 06/01/90 @ 1:20

Submitted 06/02/90

18

Volatiles Organic Compounds	mg/L	Volatiles Organic Compounds	mg/L
1,1,1,2-Tetrachloroethane	<1.0	Dichloromethane	1.0
Ethylbenzene	<1.0	Chlorobenzene	<1.0
p-Xylene	<1.0	Vinyl chloride	<0.50
m-Xylene	<1.0	Bromobenzene	<1.0
o-Xylene	<1.0	Chloroethane	<1.0
Styrene	<1.0	Trichloroethylene	<1.0*
Bromobenzene	<1.0	1,1-Dichloroethane	<0.50
Isopropylbenzene	<1.0	Methylene chloride	<1.0
1,1,2,2-Tetrachloroethane	<1.0	trans-1,2-Dichloroethane	<1.0
Bromobenzene	<1.0	1,1-Dichloroethane	<1.0*
1,2,3-Trichloropropane	<1.0	2,2-Dichloropropane	<1.0
n-Propylbenzene	<1.0	cis-1,2-Dichloroethane	<1.0
2-Chlorotoluene	<1.0	Chloroform	1.5
1,3,5-Trimethylbenzene	<1.0	Bromobenzene	<1.0
4-Chlorotoluene	<1.0	1,1,1-Trichloroethane	0.57
tert-Butylbenzene	<1.0	Carbon Tetrachloride	<0.50
1,2,4-Trimethylbenzene	<1.0	1,1-Dichloropropane	<1.0
sec-Butylbenzene	<1.0	Benzene	<0.50
p-Isopropyltoluene	<1.0	1,2-Dichlorobenzene	<0.50
1,3-Dichlorobenzene	<0.50	Trichloroethene	<0.50*
1,4-Dichlorobenzene	<1.0	1,2-Dichloropropane	<1.0
n-Butylbenzene	<1.0	Bromochloroethane	<1.0
1,2-Dichlorobenzene	<1.0	Dichloromethane	<1.0
1,2-Dibromo-3-Chloropropane	<1.0	Toluene	<1.0
1,2,4-Trichlorobenzene	<1.0	1,1,2-Trichloroethane	<1.0
Hexachlorobenzene	<1.0	Tetrachloroethane	1.7
Naphthalene	<1.0	1,2-Dichloropropane	<1.0
1,2,3-Trichlorobenzene	<1.0	Dibromochloroethane	<1.0
cis-1,2-Dichloropropane	<1.0	1,2-Dichlorobenzene	<1.0
trans-1,2-Dichloropropane	<1.0	Chlorobenzene	<1.0
Dichloromethane	<1.0		

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed according with EPA Method 802.2.

*Present but less than the practical quantitation limit.
COMPLETE ENVIRONMENTAL ANALYTICAL SERVICE

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Bill Peery
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-14926
DATE: 06/18/90 dya

WATER ANALYSIS

Helena Landfill

HL-0690-201

Sampled 06/01/90 @ 1350

Submitted 06/05/90

51

<u>Volatile Organic Constituent</u>	<u>µg/l</u>	<u>Volatile Organic Constituent</u>	<u>µg/l</u>
Dichlorodifluoromethane	1.8	1,1,1,2-Tetrachloroethane	<1.0
Chloromethane	<1.0	Ethylbenzene	<1.0
Vinyl chloride	<0.50	p-Xylene	<1.0
Bromomethane	<1.0	m-Xylene	<1.0
Chloroethane	<1.0	o-Xylene	<1.0
Trichlorofluoromethane	<1.0*	Styrene	<1.0
1,1-Dichloroethene	<0.50	Bromoform	<1.0
Methylene Chloride	<1.0	Isopropylbenzene	<1.0
trans-1,2-Dichloroethene	<1.0	1,1,2,2-Tetrachloroethane	<1.0
1,1-Dichloroethane	<1.0*	Bromobenzene	<1.0
2,2-Dichloropropane	<1.0	1,2,3-Trichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0	n-Propylbenzene	<1.0
Chloroform	2.3	2-Chlorotoluene	<1.0
Bromochloromethane	<1.0	1,3,5-Trimethylbenzene	<1.0
1,1,1-Trichloroethane	0.54	4-Chlorotoluene	<1.0
Carbon Tetrachloride	<0.50	tert-Butylbenzene	<1.0
1,1-Dichloropropene	<1.0	1,2,4-Trimethylbenzene	<1.0
Benzene	<0.50	sec-Butylbenzene	<1.0
1,2-Dichloroethane	<0.50	p-Isopropyltoluene	<1.0
Trichloroethene	<0.50*	1,3-Dichlorobenzene	<1.0
1,2-Dichloropropane	<1.0	1,4-Dichlorobenzene	<0.50
Bromodichloromethane	<1.0	n-Butylbenzene	<1.0
Dibromomethane	<1.0	1,2-Dichlorobenzene	<1.0
Toluene	<1.0	1,2-Dibromo-3-Chloropropane	<1.0
1,1,2-Trichloroethane	<1.0	1,2,4-Trichlorobenzene	<1.0
Tetrachloroethene	1.7	Hexachlorobutadiene	<1.0
1,3-Dichloropropane	<1.0	Naphthalene	<1.0
Dibromochloromethane	<1.0	1,2,3-Trichlorobenzene	<1.0
1,2-Dibromoethane	<1.0	cis-1,3-Dichloropropene	<1.0
Chlorobenzene	<1.0	trans-1,3-Dichloropropene	<1.0
		Dichloromonofluoromethane	<1.0*

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA Method 502.2.

*Present but less than the practical quantitation limit.

COMPLETE ENVIRONMENTAL ANALYTICAL SERVICE

LABORATORY REPORT

LAB NO: 10-1422
 DATE: 08/19/90

TO: [REDACTED]
 200 Perry
 100 Airport Road
 Haverhill, MA 01830

WATER ANALYSIS

Water Sample
 Sampled 08/19/90 @ 10:00
 Submitted 08/19/90

21

Volatiles Organic Compounds	mg/L	Volatiles Organic Compounds	mg/L
1,1,1,2-Tetrachloroethane	<1.0	1,1,1,2-Tetrachloroethane	1.8
Ethylbenzene	<1.0	Ethylbenzene	<1.0
p-Xylene	<1.0	p-Xylene	<0.50
m-Xylene	<1.0	m-Xylene	<1.0
o-Xylene	<1.0	o-Xylene	<1.0
Styrene	<1.0	Styrene	<1.0*
Bromobenzene	<1.0	Bromobenzene	<0.50
Isopropylbenzene	<1.0	Isopropylbenzene	<1.0
1,1,2,2-Tetrachloroethane	<1.0	1,1,2,2-Tetrachloroethane	<1.0
Bromobenzene	<1.0	Bromobenzene	<1.0*
1,2,3-Trichlorobenzene	<1.0	1,2,3-Trichlorobenzene	<1.0
n-Propylbenzene	<1.0	n-Propylbenzene	<1.0
2-Chlorotoluene	<1.0	2-Chlorotoluene	2.3
1,2,3-Trichlorobenzene	<1.0	1,2,3-Trichlorobenzene	<1.0
4-Chlorotoluene	<1.0	4-Chlorotoluene	0.54
tert-Butylbenzene	<1.0	tert-Butylbenzene	<0.50
1,2,4-Trichlorobenzene	<1.0	1,2,4-Trichlorobenzene	<1.0
sec-Butylbenzene	<1.0	sec-Butylbenzene	<0.50
p-Propyltoluene	<1.0	p-Propyltoluene	<0.50
1,2-Dichlorobenzene	<0.50	1,2-Dichlorobenzene	<0.50*
1,4-Dichlorobenzene	<1.0	1,4-Dichlorobenzene	<1.0
n-Butylbenzene	<1.0	n-Butylbenzene	<1.0
1,3-Dichlorobenzene	<1.0	1,3-Dichlorobenzene	<1.0
1,2-Dichloro-3-Chloropropane	<1.0	1,2-Dichloro-3-Chloropropane	<1.0
1,2,4-Trichlorobenzene	<1.0	1,2,4-Trichlorobenzene	<1.0
Heptachlorobutadiene	<1.0	Heptachlorobutadiene	1.7
Naphthalene	<1.0	Naphthalene	<1.0
1,2,3-Trichlorobenzene	<1.0	1,2,3-Trichlorobenzene	<1.0
cis-1,2-Dichloropropane	<1.0	cis-1,2-Dichloropropane	<1.0
trans-1,2-Dichloropropane	<1.0	trans-1,2-Dichloropropane	<1.0
Dichloromethane	<1.0*	Dichloromethane	<1.0

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed according to EPA Method 821.1.

*Present but less than the practical quantitation limit.
 COMPLETE ENVIRONMENTAL ANALYTICAL SERVICE

LABORATORY REPORT

PAGE : 1

 To : Hydrometrics
 Address : Attn: Steve Downs
2727 Airport Road
Helena, MT 59601

 Lab No. : 91-12765
 Date : 6/21/91
WATER ANALYSIS REPORT

 Sample Pt Name : HL-9104-102
 Sample Date : 4/ 4/91
 Sample Time : 13:30:00
 Sample Received : 4/ 9/91

Helena Landfill

 PHASE 1-Volatile Organic Constituents
 EPA Method 624, Revised 06/21/91

LABORATORY DATA:

Acetone-----	(ug/l)----	<10
Acrolein-----	(ug/l)----	<10
Acrylonitrile-----	(ug/l)----	<10
Benzene-----	(ug/l)----	<0.50
Bromochloromethane-----	(ug/l)----	<1.0
Bromodichloromethane-----	(ug/l)----	<1.0
trans-1,3-Dichloropropene-----	(ug/l)----	<1.0
trans-1,3-Dichloropropene-----	(ug/l)----	<1.0
1,4-Difluorobenzene-----	(ug/l)----	<10
Ethanol-----	(mg/l)----	<10
Ethylbenzene-----	(ug/l)----	<1.0
Ethyl methacrylate-----	(ug/l)----	<10
4-Bromofluorobenzene-----	(ug/l)----	<10
Bromoform-----	(ug/l)----	<1.0
Bromomethane-----	(ug/l)----	<1.0
2-Butanone(Methyl Ethyl Ketone)-----	(ug/l)----	<10
Carbon disulfide-----	(ug/l)----	<10
Carbon Tetrachloride-----	(ug/l)----	<0.50
Chlorobenzene-----	(ug/l)----	<1.0
Dibromochloromethane-----	(ug/l)----	<1.0
Chloroethane-----	(ug/l)----	<1.0
2-Chloroethylvinyl ether-----	(ug/l)----	<10
Chloroform-----	(ug/l)----	4.3
Chloromethane-----	(ug/l)----	<1.0
Dibromomethane-----	(ug/l)----	<1.0
1,4-Dichloro-2-butene-----	(ug/l)----	<10
Dichlorodifluoromethane-----	(ug/l)----	3.2
1,1-Dichloroethane-----	(ug/l)----	<1.0
1,2-Dichloroethane-----	(ug/l)----	<0.50
2-Hexanone-----	(ug/l)----	<10
Iodomethane-----	(ug/l)----	<10
Methylene Chloride-----	(ug/l)----	<1.0
Methyl-2-pentanone-----	(ug/l)----	<10
1,1-Dichloroethene-----	(ug/l)----	<0.50
trans-1,2-Dichloroethene-----	(ug/l)----	<1.0

LABORATORY REPORT

PAGE : 1

Lab No. : 91-12325
Date : 6/22/91

Hydrocarbons
Sample Name :
Sample Location :
Sample Date :
Sample Time :
Sample Received :
Helena, MT 59601

WATER ANALYTICAL REPORT
Sample Name : HL-9104-102
Sample Date : 4/4/91
Sample Time : 13:30:00
Sample Received : 4/9/91
Helena, MT 59601
PHASE I-Volatile Organic Constituents
EPA Method 814, Revised 06/21/91

LABORATORY DATA

<10	(ug/l)	Acetone
<10	(ug/l)	Acetaldehyde
<10	(ug/l)	Acrylonitrile
<0.50	(ug/l)	Benzene
<1.0	(ug/l)	Bromochloromethane
<1.0	(ug/l)	Bromodichloromethane
<1.0	(ug/l)	1,1,1-Trichloroethane
<1.0	(ug/l)	1,1,2-Trichloroethane
<1.0	(ug/l)	1,2-Dichloroethane
<1.0	(ug/l)	1,1-Dichloroethane
<1.0	(ug/l)	Ethanol
<1.0	(ug/l)	Ethylbenzene
<1.0	(ug/l)	Ethyl methacrylate
<1.0	(ug/l)	4-Bromobenzonitrile
<1.0	(ug/l)	Bromobenzene
<1.0	(ug/l)	Bromotoluene
<1.0	(ug/l)	1-Bromobenzene (Nonyl Ketone)
<1.0	(ug/l)	Carbon disulfide
<0.50	(ug/l)	Carbon tetrachloride
<1.0	(ug/l)	Chlorobenzene
<1.0	(ug/l)	Dibromochloromethane
<1.0	(ug/l)	Chloroethane
<1.0	(ug/l)	3-Chlorobenzyl ethyl ether
<1.0	(ug/l)	Chloroform
<1.0	(ug/l)	Chlorobenzene
<1.0	(ug/l)	Dibromochloromethane
<1.0	(ug/l)	1,1-Dichloro-2-butene
<1.0	(ug/l)	Dibromodichloromethane
<0.50	(ug/l)	1,1-Dichloroethane
<1.0	(ug/l)	1,2-Dichloroethane
<1.0	(ug/l)	1-Pentene
<1.0	(ug/l)	Iodobenzene
<1.0	(ug/l)	Helena Chloride
<0.50	(ug/l)	Nonyl-1-pentanone
<1.0	(ug/l)	1-Chlorobenzene
<1.0	(ug/l)	trans-1,2-Dichloroethane

LABORATORY REPORT

PAGE : 2

To : Hydrometrics
Address : Attn: Steve Downs
2727 Airport Road
Helena, MT 59601

Lab No. : 91-12765
Date : 6/21/91

WATER ANALYSIS REPORT

Sample Pt Name : HL-9104-102
Sample Date : 4/ 4/91
Sample Time : 13:30:00
Sample Received : 4/ 9/91
Helena Landfill

PHASE 1-Volatile Organic Constituents
EPA Method 624, Revised 06/21/91

LABORATORY DATA:

Styrene-----	(ug/l)----	<1.0
1,1,2,2-Tetrachloroethane-----	(ug/l)----	<1.0
Toluene-----	(ug/l)----	<1.0
1,1,1-Trichloroethane-----	(ug/l)----	0.60
1,1,2-Trichloroethane-----	(ug/l)----	<1.0
1,1,2,2-Tetrachloroethane-----	(ug/l)----	<0.50
1,1,2,2-Tetrachloroethane-----	(ug/l)----	<1.0*
1,2,3-Trichloropropane-----	(ug/l)----	<1.0
Vinyl acetate-----	(ug/l)----	<10
Vinyl chloride-----	(ug/l)----	<0.50
Xylenes-----	(ug/l)----	<1.0
Tetrachloroethene-----	(ug/l)----	2.2

cc:

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Bill Peery
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-14927
DATE: 06/18/90 dya

WATER ANALYSIS

Helena Landfill

HL-0690-202

Sampled 06/01/90 @ 1450

Submitted 06/05/90

59

Volatile Organic Constituent

	<u>µg/l</u>
Dichlorodifluoromethane	1.3
Chloromethane	<1.0
Vinyl chloride	<0.50
Bromomethane	<1.0
Chloroethane	<1.0
Trichlorofluoromethane	<1.0*
1,1-Dichloroethene	<0.50
Methylene Chloride	<1.0
trans-1,2-Dichloroethene	<1.0
1,1-Dichloroethane	<1.0*
2,2-Dichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0
Chloroform	1.6
Bromochloromethane	<1.0
1,1,1-Trichloroethane	<0.50*
Carbon Tetrachloride	<0.50
1,1-Dichloropropene	<1.0
Benzene	<0.50
1,2-Dichloroethane	<0.50
Trichloroethene	<0.50
1,2-Dichloropropane	<1.0
Bromodichloromethane	<1.0
Dibromomethane	<1.0
Toluene	<1.0
1,1,2-Trichloroethane	<1.0
Tetrachloroethene	1.1
1,3-Dichloropropane	<1.0
Dibromochloromethane	<1.0
1,2-Dibromoethane	<1.0
Chlorobenzene	<1.0

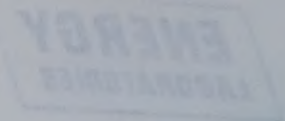
Volatile Organic Constituent

	<u>µg/l</u>
1,1,1,2-Tetrachloroethane	<1.0
Ethylbenzene	<1.0
p-Xylene	<1.0
m-Xylene	<1.0
o-Xylene	<1.0
Styrene	<1.0
Bromoform	<1.0
Isopropylbenzene	<1.0
1,1,2,2-Tetrachloroethane	<1.0
Bromobenzene	<1.0
1,2,3-Trichloropropane	<1.0
n-Propylbenzene	<1.0
2-Chlorotoluene	<1.0
1,3,5-Trimethylbenzene	<1.0
4-Chlorotoluene	<1.0
tert-Butylbenzene	<1.0
1,2,4-Trimethylbenzene	<1.0
sec-Butylbenzene	<1.0
p-Isopropyltoluene	<1.0
1,3-Dichlorobenzene	<1.0
1,4-Dichlorobenzene	<0.50
n-Butylbenzene	<1.0
1,2-Dichlorobenzene	<1.0
1,2-Dibromo-3-Chloropropane	<1.0
1,2,4-Trichlorobenzene	<1.0
Hexachlorobutadiene	<1.0
Naphthalene	<1.0
1,2,3-Trichlorobenzene	<1.0
cis-1,3-Dichloropropene	<1.0
trans-1,3-Dichloropropene	<1.0
Dichloromonofluoromethane	<1.0*

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA Method 502.2.

*Present but less than the practical quantitation limit.

COMPLETE ENVIRONMENTAL ANALYTICAL SERVICE



ENERGY LABORATORIES, INC.
 40 BOX 350 • 1ST SOUTH HIGHWAY • BRIDGE, MT 59701 • PHONE (406) 523-4222
 FAX (406) 523-4222

LABORATORY REPORT

LAB NO.: 90-14837
 DATE: 06/18/90

TO: Hydromet
 511 Ferry
 2127 Aiken Road
 Helena, MT 59601

WATER ANALYSIS

Helena Landfill
 HL-0550-202
 Sampled 06/18/90 @ 1:45
 Submitted 06/18/90
 # 29

4
 6/18/90
 11:21 AM

ug/l	Volatiles Organic Constituents	ug/l	Volatiles Organic Constituents
<1.0	1,1,1,2-Tetrachloroethane	7.5	Dichloromethane
<1.0	Ethylbenzene	<1.0	Chlorobenzene
<1.0	p-Xylene	<0.50	Vinyl chloride
<1.0	m-Xylene	<1.0	Bromobenzene
<1.0	o-Xylene	<1.0	Chloroethane
<1.0	Styrene	<1.0*	Trichloroethylene
<1.0	Bromobenzene	<0.50	1,1-Dichloroethane
<1.0	Isopropylbenzene	<1.0	Methylene chloride
<1.0	1,1,2,2-Tetrachloroethane	<1.0	trans-1,2-Dichloroethane
<1.0	Bromobenzene	<1.0*	1,1-Dichloroethane
<1.0	1,2,3-Trichloropropane	<1.0	2,2-Dichloropropane
<1.0	n-Propylbenzene	<1.0	trans-1,2-Dichloroethane
<1.0	2-Chlorotoluene	1.8	Chlorobenzene
<1.0	1,3,5-Trimethylbenzene	<1.0	Bromobenzene
<1.0	4-Chlorotoluene	<0.50*	1,1,1-Trichloroethane
<1.0	1,2,4-Trimethylbenzene	<0.50	Carbon tetrachloride
<1.0	sec-Butylbenzene	<1.0	1,1-Dichloropropane
<1.0	2-Isopropyltoluene	<0.50	Benzene
<1.0	1,3-Dichlorobenzene	<0.50	1,2-Dichlorobenzene
<0.50	1,4-Dichlorobenzene	<0.50	Trichloroethane
<1.0	n-Butylbenzene	<1.0	1,2-Dichloropropane
<1.0	1,2-Dichlorobenzene	<1.0	Bromobenzene
<1.0	1,2-Dichloro-3-Chloropropane	<1.0	Dichloromethane
<1.0	1,3,4-Trichlorobenzene	<1.0	Toluene
<1.0	Hexachlorobutadiene	<1.0	1,1,2-Trichloroethane
<1.0	Naphthalene	1.7	Trichloroethane
<1.0	1,2,3-Trichlorobenzene	<1.0	1,2-Dichloropropane
<1.0	trans-1,2-Dichloropropane	<1.0	Dichloromethane
<1.0	trans-1,2-Dichloropropane	<1.0	1,2-Dichlorobenzene
<1.0	Dichloromethane	<1.0	Chlorobenzene

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA Method 802.2.
 *Present but less than the practical quantitation limit.
 COMPLETE ENVIRONMENTAL ANALYTICAL SERVICE

LABORATORY REPORT
PAGE : 1

To : Hydrometrics
Address : Attn: Steve Downs
2727 Airport Road
Helena, MT 59601

Lab No. : 91-12766
Date : 6/21/91

WATER ANALYSIS REPORT

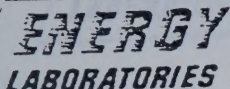
Sample Pt Name : HL9104-103
Sample Date : 4/ 4/91
Sample Time : 14:00:00
Sample Received : 4/ 9/91

Helena Landfill

PHASE 1-Volatile Organic Constituents
EPA Method 624, Revised 06/21/91

LABORATORY DATA:

Acetone-----	(ug/l)----	<10
Acrolein-----	(ug/l)----	<10
Acrylonitrile-----	(ug/l)----	<10
Benzene-----	(ug/l)----	<0.50
Bromochloromethane-----	(ug/l)----	<1.0
Bromodichloromethane-----	(ug/l)----	<1.0
cis-1,3-Dichloropropene-----	(ug/l)----	<1.0
trans-1,3-Dichloropropene-----	(ug/l)----	<1.0
1,4-Difluorobenzene-----	(ug/l)----	<10
Ethanol-----	(mg/l)----	<10
Ethylbenzene-----	(ug/l)----	<1.0
Ethyl methacrylate-----	(ug/l)----	<10
4-Bromofluorobenzene-----	(ug/l)----	<10
Bromoform-----	(ug/l)----	<1.0
Bromomethane-----	(ug/l)----	<1.0
2-Butanone(Methyl Ethyl Ketone)-----	(ug/l)----	<10
Carbon disulfide-----	(ug/l)----	<10
Carbon Tetrachloride-----	(ug/l)----	<0.50
Chlorobenzene-----	(ug/l)----	<1.0
Dibromochloromethane-----	(ug/l)----	<1.0
Chloroethane-----	(ug/l)----	<1.0
2-Chloroethylvinyl ether-----	(ug/l)----	<10
Chloroform-----	(ug/l)----	1.8
Chloromethane-----	(ug/l)----	<1.0
Dibromomethane-----	(ug/l)----	<1.0
1,4-Dichloro-2-butene-----	(ug/l)----	<10
Dichlorodifluoromethane-----	(ug/l)----	2.4
1,1-Dichloroethane-----	(ug/l)----	<1.0
1,2-Dichloroethane-----	(ug/l)----	<0.50
2-Hexanone-----	(ug/l)----	<10
Iodomethane-----	(ug/l)----	<10
Ethylene Chloride-----	(ug/l)----	<1.0
Methyl-2-pentanone-----	(ug/l)----	<10
1,1-Dichloroethene-----	(ug/l)----	<0.50
trans-1,2-Dichloroethene-----	(ug/l)----	<1.0



ENERGY LABORATORIES, INC.

P.O. BOX 30916 • 1107 SOUTH BROADWAY • BILLINGS, MT 59107-0916 • PHONE (406) 252-6325
FAX (406) 252-6069 • 1-800-873-5225

LABORATORY REPORT

PAGE : 2

To : Hydrometrics
Address : Attn: Steve Downs
2727 Airport Road
Helena, MT 59601

Lab No. : 91-12766
Date : 6/21/91

WATER ANALYSIS REPORT

Sample Pt Name : HL9104-103
Sample Date : 4/ 4/91
Sample Time : 14:00:00
Sample Received : 4/ 9/91

Helena Landfill

PHASE 1-Volatile Organic Constituents
EPA Method 624, Revised 06/21/91

LABORATORY DATA:

LABORATORY DATA:		
Styrene	(ug/l)	<1.0
1,1,2,2-Tetrachloroethane	(ug/l)	<1.0
Toluene	(ug/l)	<1.0
1,1,1-Trichloroethane	(ug/l)	<0.50*
1,1,2-Trichloroethane	(ug/l)	<1.0
1,2-Dichloroethane	(ug/l)	<0.50
1,1,2-Trichlorofluoromethane	(ug/l)	<1.0*
1,2,3-Trichloropropane	(ug/l)	<1.0
Vinyl acetate	(ug/l)	<10
Vinyl chloride	(ug/l)	<0.50
Xylenes	(ug/l)	<1.0
Tetrachloroethene	(ug/l)	1.3

CC:

--- AIRCRAFT ANALYTICAL SERVICE

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Bill Peery
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-14928
DATE: 06/18/90 dya

WATER ANALYSIS

Helena Landfill

HL-0690-203

Sampled 06/01/90 @ 1605

Submitted 06/05/90

#67 Deep

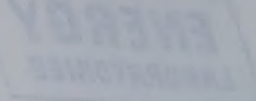
<u>Volatile Organic Constituent</u>	<u>µg/l</u>
Dichlorodifluoromethane	<1.0
Chloromethane	<1.0
Vinyl chloride	<0.50
Bromomethane	<1.0
Chloroethane	<1.0
Trichlorofluoromethane	<1.0
1,1-Dichloroethene	<0.50
Methylene Chloride	<1.0
trans-1,2-Dichloroethene	<1.0
1,1-Dichloroethane	<1.0
2,2-Dichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0
Chloroform	<1.0
Bromochloromethane	<1.0
1,1,1-Trichloroethane	<0.50
Carbon Tetrachloride	<0.50
1,1-Dichloropropene	<1.0
Benzene	<0.50
1,2-Dichloroethane	<0.50
Trichloroethene	<0.50
1,2-Dichloropropane	<1.0
Bromodichloromethane	<1.0
Dibromomethane	<1.0
Toluene	<1.0
1,1,2-Trichloroethane	<1.0
Tetrachloroethene	<0.50
1,3-Dichloropropane	<1.0
Dibromochloromethane	<1.0
1,2-Dibromoethane	<1.0
Chlorobenzene	<1.0

<u>Volatile Organic Constituent</u>	<u>µg/l</u>
1,1,1,2-Tetrachloroethane	<1.0
Ethylbenzene	<1.0
p-Xylene	<1.0
m-Xylene	<1.0
o-Xylene	<1.0
Styrene	<1.0
Bromoform	<1.0
Isopropylbenzene	<1.0
1,1,2,2-Tetrachloroethane	<1.0
Bromobenzene	<1.0
1,2,3-Trichloropropane	<1.0
n-Propylbenzene	<1.0
2-Chlorotoluene	<1.0
1,3,5-Trimethylbenzene	<1.0
4-Chlorotoluene	<1.0
tert-Butylbenzene	<1.0
1,2,4-Trimethylbenzene	<1.0
sec-Butylbenzene	<1.0
p-Isopropyltoluene	<1.0
1,3-Dichlorobenzene	<1.0
1,4-Dichlorobenzene	<0.50
n-Butylbenzene	<1.0
1,2-Dichlorobenzene	<1.0
1,2-Dibromo-3-Chloropropane	<1.0
1,2,4-Trichlorobenzene	<1.0
Hexachlorobutadiene	<1.0
Naphthalene	<1.0
1,2,3-Trichlorobenzene	<1.0
cis-1,3-Dichloropropene	<1.0
trans-1,3-Dichloropropene	<1.0
Dichloromonofluoromethane	<1.0

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed accordance with EPA Method 502.2.

*Present but less than the practical quantitation limit.

COMPLETE ENVIRONMENTAL ANALYTICAL SERVICE



ENERGY LABORATORIES, INC.
 100 BOX 2000 • 100 SOUTH BROADWAY • BRIDGEVILLE, MT 59017-0200
 TEL (406) 522-6002 • FAX (406) 522-6002

LABORATORY REPORT

LAB NO.: 90-14828
 DATE: 08/15/90

TO: [illegible]
 ADDRESS: [illegible]
 2101 1st Street
 Helena, MT 59601

WATER ANALYSIS

Submitted 08/05/90
 Sampled 08/01/90 @ 1600
 HL-0830-202
 Helena Landfill

10018
 10018
 10018

Volatiles Organic Compound	mg/L	Volatiles Organic Compound	mg/L
1,1,1,2-Tetrachloroethane	<1.0	1,1-Dichloroethane	<1.0
Ethylbenzene	<1.0	Chlorobenzene	<1.0
p-Xylene	<1.0	Vinyl chloride	<0.50
m-Xylene	<1.0	Bromobenzene	<1.0
o-Xylene	<1.0	Chloroethane	<1.0
Styrene	<1.0	1,1,2,2-Tetrachloroethane	<1.0
Bromobenzene	<1.0	1,1-Dichloroethane	<0.50
Isopropylbenzene	<1.0	Methylene Chloride	<1.0
1,1,2,2-Tetrachloroethane	<1.0	trans-1,2-Dichloroethane	<1.0
Bromobenzene	<1.0	1,1-Dichloroethane	<1.0
1,2,3-Trichloropropane	<1.0	2,2-Dichloropropane	<1.0
n-Propylbenzene	<1.0	cis-1,2-Dichloroethane	<1.0
2-Chlorotoluene	<1.0	Chloroform	<1.0
1,3,5-Trimethylbenzene	<1.0	Dimethylchloromethane	<0.50
4-Chlorotoluene	<1.0	1,1,2,2-Tetrachloroethane	<0.50
tert-Butylbenzene	<1.0	Carbon Tetrachloride	<1.0
1,2,4-Trimethylbenzene	<1.0	1,1-Dichloropropane	<0.50
sec-Butylbenzene	<1.0	Benzene	<0.50
p-Isopropyltoluene	<1.0	1,2-Dichlorobenzene	<0.50
1,3-Dichlorobenzene	<0.50	Trichlorobenzene	<1.0
1,4-Dichlorobenzene	<1.0	1,2-Dichloropropane	<1.0
n-Butylbenzene	<1.0	1,1,2,2-Tetrachloroethane	<1.0
1,2-Dichlorobenzene	<1.0	1,1-Dichloroethane	<1.0
1,2-Dichloro-3-Chloropropane	<1.0	Toluene	<1.0
1,2,4-Trichlorobenzene	<1.0	1,1,2,2-Tetrachloroethane	<0.50
Hexachlorocyclopentadiene	<1.0	1,1-Dichloroethane	<1.0
Naphthalene	<1.0	1,2-Dichlorobenzene	<1.0
1,2,3-Trichlorobenzene	<1.0	trans-1,2-Dichloroethane	<1.0
cis-1,2-Dichloropropane	<1.0	1,1-Dichloroethane	<1.0
trans-1,2-Dichloropropane	<1.0	1,2-Dichlorobenzene	<1.0
Dichloromethane	<1.0		

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed according with EPA Method 8000A.
 Present but less than the practical quantitation limit.
 COMPLETE ENVIRONMENTAL ANALYTICAL SERVICE

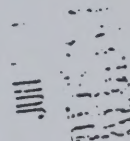
LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Bill Peery
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-14929
DATE: 06/18/90 dya

WATER ANALYSIS

Helena Landfill
HL-0690-204
Sampled 06/01/90 @ 1600
Submitted 06/05/90
#67 shallow

Volatile Organic Constituent

	<u>µg/l</u>
Dichlorodifluoromethane	<1.0*
Chloromethane	<1.0
Vinyl chloride	<0.50
Bromomethane	<1.0
Chloroethane	<1.0
Trichlorofluoromethane	<1.0
1,1-Dichloroethene	<0.50
Methylene Chloride	<1.0
trans-1,2-Dichloroethene	<1.0
1,1-Dichloroethane	<1.0
2,2-Dichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0
Chloroform	1.1
Bromochloromethane	<1.0
1,1,1-Trichloroethane	<0.50
Carbon Tetrachloride	<0.50
1,1-Dichloropropene	<1.0
Benzene	<0.50
1,2-Dichloroethane	<0.50
Trichloroethene	<1.0
1,2-Dichloropropane	<1.0
Bromodichloromethane	<1.0
Dibromomethane	<1.0
Toluene	<1.0
1,1,2-Trichloroethane	<1.0
Tetrachloroethene	0.64
1,3-Dichloropropane	<1.0
Dibromochloromethane	<1.0
1,2-Dibromoethane	<1.0
Chlorobenzene	<1.0

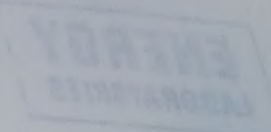
Volatile Organic Constituent

	<u>µg/l</u>
1,1,1,2-Tetrachloroethane	<1.0
Ethylbenzene	<1.0
p-Xylene	<1.0
m-Xylene	<1.0
o-Xylene	<1.0
Styrene	<1.0
Bromoform	<1.0
Isopropylbenzene	<1.0
1,1,2,2-Tetrachloroethane	<1.0
Bromobenzene	<1.0
1,2,3-Trichloropropane	<1.0
n-Propylbenzene	<1.0
2-Chlorotoluene	<1.0
1,3,5-Trimethylbenzene	<1.0
4-Chlorotoluene	<1.0
tert-Butylbenzene	<1.0
1,2,4-Trimethylbenzene	<1.0
sec-Butylbenzene	<1.0
p-Isopropyltoluene	<1.0
1,3-Dichlorobenzene	<1.0
1,4-Dichlorobenzene	<0.50
n-Butylbenzene	<1.0
1,2-Dichlorobenzene	<1.0
1,2-Dibromo-3-Chloropropane	<1.0
1,2,4-Trichlorobenzene	<1.0
Hexachlorobutadiene	<1.0
Naphthalene	<1.0
1,2,3-Trichlorobenzene	<1.0
cis-1,3-Dichloropropene	<1.0
trans-1,3-Dichloropropene	<1.0
Dichloromonofluoromethane	<1.0

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA Method 502.2.

*Present but less than the practical quantitation limit.

COMPLETE ENVIRONMENTAL ANALYTICAL SERVICE



ENERGY LABORATORIES, INC.
100 BOX 3075 • 100 SOUTH BROADWAY • SUITE 200 • NEW YORK, NY 10038
TEL: (212) 512-5555 • FAX: (212) 512-5555

LABORATORY REPORT

LAB NO: 90-14825
DATE: 08/18/90

TO: [REDACTED]
FROM: [REDACTED]
ADDRESS: 2727 Algon Road
Hempstead, NY 11551

WATER ANALYSIS
Method: Langelier
HL-0820-204
Sampled 08/18/90 @ 1000
Submitted 08/25/90
SP-5 (Langelier)

1111
08/18/90

Volatiles Organic Constituents		Non-Halogenated Organic Constituents	
1,1,1,2-Tetrachloroethane	<1.0	1,1,1,2-Tetrachloroethane	<1.0
Ethylbenzene	<1.0	Chlorobenzene	<1.0
p-Xylene	<1.0	Vinyl chloride	<1.0
m-Xylene	<1.0	Bromobenzene	<1.0
o-Xylene	<1.0	Chloroform	<1.0
Styrene	<1.0	Trichloroethylene	<1.0
Bromobenzene	<1.0	1,1-Dichloroethane	<1.0
Isopropylbenzene	<1.0	1,1,1-Trichloroethane	<1.0
1,1,2,2-Tetrachloroethane	<1.0	1,1,2-Trichloroethane	<1.0
Bromobenzene	<1.0	1,2-Dichlorobenzene	<1.0
1,2,3-Trichloropropane	<1.0	1,3-Dichlorobenzene	<1.0
n-Propylbenzene	<1.0	2-Chlorotoluene	<1.0
2-Chlorotoluene	<1.0	1,3,5-Trimethylbenzene	<1.0
1,3,5-Trimethylbenzene	<1.0	4-Chlorotoluene	<1.0
4-Chlorotoluene	<1.0	tert-Butylbenzene	<1.0
tert-Butylbenzene	<1.0	1,2,4-Trimethylbenzene	<1.0
1,2,4-Trimethylbenzene	<1.0	sec-Butylbenzene	<1.0
sec-Butylbenzene	<1.0	p-Isopropyltoluene	<1.0
p-Isopropyltoluene	<1.0	1,3-Dichlorobenzene	<1.0
1,3-Dichlorobenzene	<1.0	1,4-Dichlorobenzene	<1.0
1,4-Dichlorobenzene	<1.0	n-Butylbenzene	<1.0
n-Butylbenzene	<1.0	1,2-Dichlorobenzene	<1.0
1,2-Dichlorobenzene	<1.0	1,2-Dichloro-3-Chloropropane	<1.0
1,2-Dichloro-3-Chloropropane	<1.0	1,2,4-Trichlorobenzene	<1.0
1,2,4-Trichlorobenzene	<1.0	Hexachlorobutadiene	<1.0
Hexachlorobutadiene	<1.0	Naphthalene	<1.0
Naphthalene	<1.0	1,2,3-Trichlorobenzene	<1.0
1,2,3-Trichlorobenzene	<1.0	1,2,3-Trichloropropane	<1.0
1,2,3-Trichloropropane	<1.0	trans-1,2-Dichloroethane	<1.0
trans-1,2-Dichloroethane	<1.0	Dichloromethane	<1.0
Dichloromethane	<1.0		

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed according to EPA Method 821.2.
*Present but less than the practical quantitation limit.
COMPLETE ENVIRONMENTAL ANALYTICAL SERVICE

LABORATORY REPORT

PAGE : 1

To : Hydrometrics
Address : Attn: Steve Downs
2727 Airport Road
Helena, MT 59601

Lab No. : 91-12764
Date : 6/21/91

WATER ANALYSIS REPORT

Sample Pt Name : HL9104-101
Sample Date : 4/ 4/91
Sample Time : 12:00:00
Sample Received : 4/ 9/91
Helena Landfill

PHASE 1-Volatile Organic Constituents
EPA Method 624, Revised 06/21/91

LABORATORY DATA:

Acetone-----	(ug/l)----	<10
Acrolein-----	(ug/l)----	<10
Acrylonitrile-----	(ug/l)----	<10
Benzene-----	(ug/l)----	<0.50
Bromochloromethane-----	(ug/l)----	<1.0
Bromodichloromethane-----	(ug/l)----	<1.0
trans-1,3-Dichloropropene-----	(ug/l)----	<1.0
trans-1,3-Dichloropropene-----	(ug/l)----	<1.0
1,4-Difluorobenzene-----	(ug/l)----	<10
Ethanol-----	(mg/l)----	<10
Ethylbenzene-----	(ug/l)----	<1.0
Ethyl methacrylate-----	(ug/l)----	<10
4-Bromofluorobenzene-----	(ug/l)----	<10
Bromoform-----	(ug/l)----	<1.0
Bromomethane-----	(ug/l)----	<1.0
2-Butanone(Methyl Ethyl Ketone)-----	(ug/l)----	<10
Carbon disulfide-----	(ug/l)----	<10
Carbon Tetrachloride-----	(ug/l)----	<0.50
Chlorobenzene-----	(ug/l)----	<1.0
Dibromochloromethane-----	(ug/l)----	<1.0
Chloroethane-----	(ug/l)----	<1.0
2-Chloroethylvinyl ether-----	(ug/l)----	<10
Chloroform-----	(ug/l)----	<1.0
Chloromethane-----	(ug/l)----	<1.0
Dibromomethane-----	(ug/l)----	<1.0
1,4-Dichloro-2-butene-----	(ug/l)----	<10
Dichlorodifluoromethane-----	(ug/l)----	<1.0
1,1-Dichloroethane-----	(ug/l)----	<1.0
1,2-Dichloroethane-----	(ug/l)----	<0.50
2-Hexanone-----	(ug/l)----	<10
Iodomethane-----	(ug/l)----	<10
Ethylene Chloride-----	(ug/l)----	<1.0
Methyl-2-pentanone-----	(ug/l)----	<10
1,1-Dichloroethene-----	(ug/l)----	<0.50
trans-1,2-Dichloroethene-----	(ug/l)----	<1.0

LABORATORY REPORT

PAGE: 1

Lab No.: 91-1276
Date: 5/2/91

Client: State Dept
1111 Avenue of the Americas
New York, NY 10020

WATER ANALYSIS REPORT

Sample ID: H1010-101
Sample Date: 4/2/91
Sample Time: 12:00:00
Sample Received: 4/2/91

Helena Landfill

PHASE 1-Volatile Organic Compounds
EPA Method 824, Revised 02/2/91

LABORATORY DATA

Acetone	(ug/l)	<1.0
Acetaldehyde	(ug/l)	<1.0
Acrylonitrile	(ug/l)	<1.0
Benzene	(ug/l)	<1.0
1,2-Dichloroethane	(ug/l)	<1.0
1,1,1-Trichloroethane	(ug/l)	<1.0
1,2-Dichloropropane	(ug/l)	<1.0
1,1-Dichloroethane	(ug/l)	<1.0
Ethanol	(ug/l)	<1.0
Ethylbenzene	(ug/l)	<1.0
Ethyl methacrylate	(ug/l)	<1.0
4-Ethyltoluene	(ug/l)	<1.0
Bromobenzene	(ug/l)	<1.0
Bromochloroethane	(ug/l)	<1.0
1-Bromobenzene (Ethyl Ketone)	(ug/l)	<1.0
Carbon disulfide	(ug/l)	<1.0
Carbon tetrachloride	(ug/l)	<1.0
Chlorobenzene	(ug/l)	<1.0
Dibromochloroethane	(ug/l)	<1.0
Chloroethane	(ug/l)	<1.0
1-Chloro-2-methyl ethyl ether	(ug/l)	<1.0
Chloroform	(ug/l)	<1.0
Chlorobenzene	(ug/l)	<1.0
Dibromochloroethane	(ug/l)	<1.0
1,4-Dichloro-1-butene	(ug/l)	<1.0
1,1-Dichloro-2-methyl ethane	(ug/l)	<1.0
1,1-Dichloroethane	(ug/l)	<1.0
1,2-Dichloroethane	(ug/l)	<1.0
2-Hexanone	(ug/l)	<1.0
Isobutylene	(ug/l)	<1.0
Ethylene Chloride	(ug/l)	<1.0
Ethyl-2-bromobenzene	(ug/l)	<1.0
1,1-Dichloroethane	(ug/l)	<1.0
Styrene-1,2-Dichloroethane	(ug/l)	<1.0

LABORATORY REPORT

PAGE : 2

To : Hydrometrics
Address : Attn: Steve Downs
2727 Airport Road
Helena, MT 59601

Lab No. : 91-12764
Date : 6/21/91

WATER ANALYSIS REPORT

Sample Pt Name : HL9104-101
Sample Date : 4/ 4/91
Sample Time : 12:00:00
Sample Received : 4/ 9/91

Helena Landfill

PHASE 1-Volatile Organic Constituents
EPA Method 624, Revised 06/21/91

LABORATORY DATA:

Styrene-----	(ug/l)----	<1.0
1,1,2,2-Tetrachloroethane-----	(ug/l)----	<1.0
Toluene-----	(ug/l)----	<1.0
1,1,1-Trichloroethane-----	(ug/l)----	<0.50
1,1,2-Trichloroethane-----	(ug/l)----	<1.0
1,1-Dichloroethene-----	(ug/l)----	<0.50
1,1-Dichlorofluoromethane-----	(ug/l)----	<1.0
1,2,3-Trichloropropane-----	(ug/l)----	<1.0
Vinyl acetate-----	(ug/l)----	<10
Vinyl chloride-----	(ug/l)----	<0.50
Xylenes-----	(ug/l)----	<1.0
Tetrachloroethene-----	(ug/l)----	<0.50

CC:

LABORATORY REPORT

PAGE : 1

Lab No. : 91-10000
Date : 6/10/91

Project :
Client :
Address :
City :
State :
Zip :

WATER ANALYSIS REPORT

Sample Name : H10104-101
Sample Date : 4/4/91
Sample Time : 11:00:00
Sample Received : 4/9/91
Helena Landfill
Phase I-Volatile Organic Constituents
EPA Method 824, Revised 06/21/91

<1.0	(ug/l)	1,1,1,2,2-Pentachloroethane
<1.0	(ug/l)	1,1,1,2,2-Pentachloroethane
<1.0	(ug/l)	1,1,1,2,2-Pentachloroethane
<0.50	(ug/l)	1,1,1,2,2-Pentachloroethane
<1.0	(ug/l)	1,1,1,2,2-Pentachloroethane
<0.50	(ug/l)	1,1,1,2,2-Pentachloroethane
<1.0	(ug/l)	1,1,1,2,2-Pentachloroethane
<1.0	(ug/l)	1,1,1,2,2-Pentachloroethane
<1.0	(ug/l)	1,1,1,2,2-Pentachloroethane
<0.50	(ug/l)	1,1,1,2,2-Pentachloroethane
<0.50	(ug/l)	1,1,1,2,2-Pentachloroethane
<1.0	(ug/l)	1,1,1,2,2-Pentachloroethane
<1.0	(ug/l)	1,1,1,2,2-Pentachloroethane
<0.50	(ug/l)	1,1,1,2,2-Pentachloroethane
<1.0	(ug/l)	1,1,1,2,2-Pentachloroethane
<0.50	(ug/l)	1,1,1,2,2-Pentachloroethane

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Randy Huffsmith
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-15044
DATE: 06/18/90 dya

WATER ANALYSIS

Helena City Landfill

HL-9006-106

Sampled 06/06/90 @ 1245

Submitted 06/07/90

#84

<u>Volatile Organic Constituent</u>	<u>µg/l</u>	<u>Volatile Organic Constituent</u>	<u>µg/l</u>
Dichlorodifluoromethane	<1.0	1,1,1,2-Tetrachloroethane	<1.0
Chloromethane	<1.0	Ethylbenzene	<1.0
Vinyl chloride	<0.50	p-Xylene	<1.0
Bromomethane	<1.0	m-Xylene	<1.0
Chloroethane	<1.0	o-Xylene	<1.0
Trichlorofluoromethane	<1.0	Styrene	<1.0
1,1-Dichloroethene	<0.50	Bromoform	<1.0
Methylene Chloride	<1.0	Isopropylbenzene	<1.0
trans-1,2-Dichloroethene	<1.0	1,1,2,2-Tetrachloroethane	<1.0
1,1-Dichloroethane	<1.0	Bromobenzene	<1.0
2,2-Dichloropropane	<1.0	1,2,3-Trichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0	n-Propylbenzene	<1.0
Chloroform	<1.0	2-Chlorotoluene	<1.0
Bromochloromethane	<1.0	1,3,5-Trimethylbenzene	<1.0
1,1,1-Trichloroethane	<0.50	4-Chlorotoluene	<1.0
Carbon Tetrachloride	<0.50	tert-Butylbenzene	<1.0
1,1-Dichloropropene	<1.0	1,2,4-Trimethylbenzene	<1.0
Benzene	<0.50	sec-Butylbenzene	<1.0
1,2-Dichloroethane	<0.50	p-Isopropyltoluene	<1.0
Trichloroethene	<0.50	1,3-Dichlorobenzene	<1.0
1,2-Dichloropropane	<1.0	1,4-Dichlorobenzene	<0.50
Bromodichloromethane	<1.0	n-Butylbenzene	<1.0
Dibromomethane	<1.0	1,2-Dichlorobenzene	<1.0
Toluene	<1.0	1,2-Dibromo-3-Chloropropane	<1.0
1,1,2-Trichloroethane	<1.0	1,2,4-Trichlorobenzene	<1.0
Tetrachloroethene	<0.50	Hexachlorobutadiene	<1.0
1,3-Dichloropropane	<1.0	Naphthalene	<1.0
Dibromochloromethane	<1.0	1,2,3-Trichlorobenzene	<1.0
1,2-Dibromoethane	<1.0	cis-1,3-Dichloropropene	<1.0
Chlorobenzene	<1.0	trans-1,3-Dichloropropene	<1.0
		Dichloromonofluoromethane	<1.0

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA Method 502.2.

*Present but less than the practical quantitation limit.

COMPLETE ENVIRONMENTAL ANALYTICAL SERVICE

LABORATORY REPORT

LAB NO.: 60-15042
DATE: 08/18/90 dya

TO: Hydrometals
ADDRESS: Randy Hoffman
2701 Airport Road
Helena, MT 59601

WATER ANALYSIS
Helena City Landfill
HL-9008-108
Sampled 08/08/90 @ 12:45
Submitted 08/07/90

784

Volatile Organic Compounds		Volatile Organic Compounds	
1,1,1-Trichloroethane	<1.0	1,1,1-Trichloroethane	<1.0
Ethylbenzene	<1.0	Ethylbenzene	<1.0
p-Xylene	<1.0	p-Xylene	<1.0
m-Xylene	<1.0	m-Xylene	<1.0
o-Xylene	<1.0	o-Xylene	<1.0
Styrene	<1.0	Styrene	<1.0
Bromobenzene	<1.0	Bromobenzene	<1.0
Isopropylbenzene	<1.0	Isopropylbenzene	<1.0
1,1,2,2-Tetrachloroethane	<1.0	1,1,2,2-Tetrachloroethane	<1.0
Bromobenzene	<1.0	Bromobenzene	<1.0
1,2,3-Trichlorobenzene	<1.0	1,2,3-Trichlorobenzene	<1.0
p-Propylbenzene	<1.0	p-Propylbenzene	<1.0
2-Chlorotoluene	<1.0	2-Chlorotoluene	<1.0
1,2,3-Trimethylbenzene	<1.0	1,2,3-Trimethylbenzene	<1.0
4-Chlorotoluene	<1.0	4-Chlorotoluene	<1.0
tert-Butylbenzene	<1.0	tert-Butylbenzene	<1.0
1,2,4-Trimethylbenzene	<1.0	1,2,4-Trimethylbenzene	<1.0
sec-Butylbenzene	<1.0	sec-Butylbenzene	<1.0
p-Isopropyltoluene	<1.0	p-Isopropyltoluene	<1.0
1,3-Dichlorobenzene	<1.0	1,3-Dichlorobenzene	<1.0
1,4-Dichlorobenzene	<1.0	1,4-Dichlorobenzene	<1.0
n-Butylbenzene	<1.0	n-Butylbenzene	<1.0
1,2-Dichlorobenzene	<1.0	1,2-Dichlorobenzene	<1.0
1,3-Dichloro-3-Chloropropene	<1.0	1,3-Dichloro-3-Chloropropene	<1.0
1,2,4-Trichlorobenzene	<1.0	1,2,4-Trichlorobenzene	<1.0
Hexachlorobutadiene	<1.0	Hexachlorobutadiene	<1.0
Naphthalene	<1.0	Naphthalene	<1.0
1,2,3-Trichlorobenzene	<1.0	1,2,3-Trichlorobenzene	<1.0
cis-1,2-Dichloropropene	<1.0	cis-1,2-Dichloropropene	<1.0
trans-1,2-Dichloropropene	<1.0	trans-1,2-Dichloropropene	<1.0
Dichloromethane	<1.0	Dichloromethane	<1.0

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed according with EPA Method 821.2.
*Present but less than the practical quantitation limit.
COMPLETE ENVIRONMENTAL ANALYTICAL SERVICE

**ENERGY
LABORATORIES**
ENERGY LABORATORIES, INC.

 P.O. BOX 30916 • 1107 SOUTH BROADWAY • BILLINGS, MT 59107-0916 • PHONE (406) 252-6325
 FAX (406) 252-6069 • 1-800-873-5227

LABORATORY REPORT

PAGE : 1

 To : Hydrometrics
 Address : Attn: Steve Downs
2727 Airport Road
Helena, MT 59601

 Lab No. : 91-12768
 Date : 6/21/91
WATER ANALYSIS REPORT

 Sample Pt Name : HL9104-105
 Sample Date : 4/ 5/91
 Sample Time : 12:00:00
 Sample Received : 4/ 9/91

Helena Landfill

 PHASE 1-Volatile Organic Constituents
 EPA Method 624, Revised 06/21/91

LABORATORY DATA:

Acetone-----	(ug/l)----	<10
Acrolein-----	(ug/l)----	<10
Acrylonitrile-----	(ug/l)----	<10
Benzene-----	(ug/l)----	<0.50*
Bromochloromethane-----	(ug/l)----	<1.0
1,1-Dichloromethane-----	(ug/l)----	<1.0
trans-1,3-Dichloropropene-----	(ug/l)----	<1.0
trans-1,3-Dichloropropene-----	(ug/l)----	<1.0
1,4-Difluorobenzene-----	(ug/l)----	<10
Ethanol-----	(mg/l)----	<10
Ethylbenzene-----	(ug/l)----	<1.0
Ethyl methacrylate-----	(ug/l)----	<10
4-Bromofluorobenzene-----	(ug/l)----	<10
Bromoform-----	(ug/l)----	<1.0
Bromomethane-----	(ug/l)----	<1.0
2-Butanone(Methyl Ethyl Ketone)-----	(ug/l)----	<10
Carbon disulfide-----	(ug/l)----	<10
Carbon Tetrachloride-----	(ug/l)----	<0.50
Chlorobenzene-----	(ug/l)----	<1.0
Dibromochloromethane-----	(ug/l)----	<1.0
Chloroethane-----	(ug/l)----	<1.0
2-Chloroethylvinyl ether-----	(ug/l)----	<10
Chloroform-----	(ug/l)----	7.0
Chloromethane-----	(ug/l)----	<1.0
Dibromomethane-----	(ug/l)----	<1.0
1,4-Dichloro-2-butene-----	(ug/l)----	<10
Dichlorodifluoromethane-----	(ug/l)----	11
1,1-Dichloroethane-----	(ug/l)----	3.8
1,2-Dichloroethane-----	(ug/l)----	<0.50
2-Hexanone-----	(ug/l)----	<10
Iodomethane-----	(ug/l)----	<10
Ethylene Chloride-----	(ug/l)----	4.2
Methyl-2-pentanone-----	(ug/l)----	<10
1,1-Dichloroethene-----	(ug/l)----	<0.50
trans-1,2-Dichloroethene-----	(ug/l)----	<1.0

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 FAX (406) 252-6069 • 1-800-873-5227

LABORATORY REPORT

PAGE : 2

 To : Hydrometrics
 Address : Attn: Steve Downs
2727 Airport Road
Helena, MT 59601

 Lab No. : 91-12768
 Date : 6/21/91
WATER ANALYSIS REPORT

 Sample Pt Name : HL9104-105
 Sample Date : 4/ 5/91
 Sample Time : 12:00:00
 Sample Received : 4/ 9/91

Helena Landfill

 PHASE 1-Volatile Organic Constituents
 EPA Method 624, Revised 06/21/91

LABORATORY DATA:

Styrene-----	(ug/l)----	<1.0
1,1,2,2-Tetrachloroethane-----	(ug/l)----	<1.0
Toluene-----	(ug/l)----	<1.0
1,1,1-Trichloroethane-----	(ug/l)----	<0.50
1,1,2-Trichloroethane-----	(ug/l)----	<1.0
1,2-Dichloroethene-----	(ug/l)----	7.4
1,1-Dichlorofluoromethane-----	(ug/l)----	4.3
1,2,3-Trichloropropane-----	(ug/l)----	<1.0
Vinyl acetate-----	(ug/l)----	<10
Vinyl chloride-----	(ug/l)----	<0.50
Xylenes-----	(ug/l)----	<1.0
Tetrachloroethene-----	(ug/l)----	66

cc:

LAB. NO. 005550 MONTANA DEPARTMENT OF HEALTH
AND ENVIRONMENTAL SCIENCES
Public Health Lab, W.F. Cogswell Building, Helena, Montana 59620
Phone: 444-2642

SAMPLING PROCEDURE:

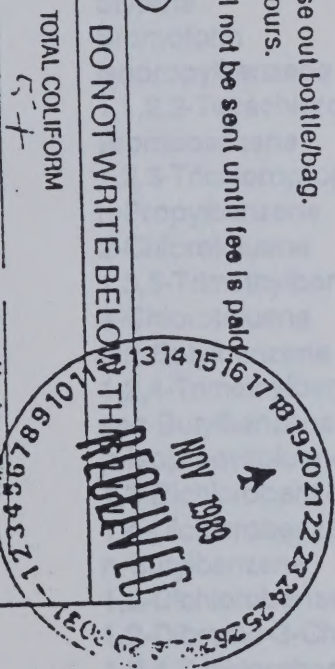
1. Remove screen. Allow water to run 2 - 3 minutes.
2. Fill bottle or bag to $\frac{3}{4}$ full — without touching inside. Do not rinse out bottle/bag.
3. Fill out sampling information below and return to lab within 48 hours.
4. **Enclose \$6.50 check or money order to cover cost. Results will not be sent until fee is paid.**

Received 11-14-89 Reported 11-16-89

DATE Collected 11-13-89 Time 1130
Owner of Water Source Helena Landfill PMU-1
Location of Water Source Helena MT
Nearest City

County _____
Type of Supply (Circle One) Cistern Well Spring River Other
(Please Specify) AG. Victoria
Collector of Sample: W. Becht Phone No. 443-4150

Person to Receive Report (Please Print):
NAME: Hydromedics - Randy McNair
Street or RFD: 2727 Airport rd
City: Helena MT Zip: 59601



DO NOT WRITE BELOW THIS LINE

TOTAL COLIFORM	Multiple Tube	Membrane Filter
<u>5+</u>		
FECAL COLIFORM	Multiple Tube	Membrane Filter
☐ Suitable for drinking.		
REMARKS: <u>OK</u>		
☒ Contaminated. Water supply should be disinfected and retested before it is used as drinking water or for household purposes. Consult your county sanitarian for treatment procedures.		

W. Becht

City Helena

or the Capital

Street or hwy 5555 BroadwayName Walter J. R. - Grand W. W. R.

Person to receive report (Address Print)

Collection of Sample W. J. R. - W. W. R. - W. W. R.Date of Sample 11-11-83Place of Sample (State and City) Mont. HelenaLocation of Water Source W. J. R. - W. W. R. - W. W. R.Date Collected 11-11-83Time 11:30

4. Evaluate for 20 types of water quality (see list)

5. Fill out sampling information below and return to lab within 48 hours

6. Return section with water to run 5 - 3 minutes

ANALYZING MICROPHONE

Lab No. 605520Phone 444-5843Address 605520

MONTANA DEPARTMENT OF HEALTH

DO NOT WRITE BELOW THIS LINE

LEAD COLLECTION

DATE COLLECTED

TIME COLLECTED

LOCATION COLLECTED

NAME COLLECTED

ADDRESS COLLECTED

CITY COLLECTED

STATE COLLECTED

COUNTRY COLLECTED

LABORATORY COLLECTED

ANALYST COLLECTED

DATE ANALYZED

TIME ANALYZED

LOCATION ANALYZED

NAME ANALYZED

Unanalyzed 11-11-83Unanalyzed 11-11-83

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Billy Pratt
2727 Airport Road
Helena, MT 59601

LAB NO.: 89-20185
DATE: 11/27/89 dya

#1mw

WATER ANALYSIS

Helena Landfill
HL-8911-006

Sampled 11/13/89 @ 1130

Submitted 11/14/89

<u>Volatile Organic Constituent</u>	<u>µg/l</u>	<u>Volatile Organic Constituent</u>	<u>µg/l</u>
Dichlorodifluoromethane	<1.0	1,1,1,2-Tetrachloroethane	<1.0
Chloromethane	<1.0	Ethylbenzene	<1.0
Vinyl chloride	<0.50	p-Xylene	<1.0
Bromomethane	<1.0	m-Xylene	<1.0
Chloroethane	<1.0	o-Xylene	<1.0
Trichlorofluoromethane	<1.0	Styrene	<1.0
1,1-Dichloroethene	<0.50	Bromoform	<1.0
Methylene Chloride	<1.0	Isopropylbenzene	<1.0
trans-1,2-Dichloroethene	<1.0	1,1,2,2-Tetrachloroethane	<1.0
1,1-Dichloroethane	<1.0	Bromobenzene	<1.0
2,2-Dichloropropane	<1.0	1,2,3-Trichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0	n-Propylbenzene	<1.0
Chloroform	3.5	2-Chlorotoluene	<1.0
Bromochloromethane	<1.0	1,3,5-Trimethylbenzene	<1.0
1,1,1-Trichloroethane	<0.50*	4-Chlorotoluene	<1.0
Carbon Tetrachloride	<0.50	tert-Butylbenzene	<1.0
1,1-Dichloropropene	<1.0	1,2,4-Trimethylbenzene	<1.0
Benzene	<0.50	sec-Butylbenzene	<1.0
1,2-Dichloroethane	<0.50	p-Isopropyltoluene	<1.0
Trichloroethene	<0.50	1,3-Dichlorobenzene	<1.0
1,2-Dichloropropane	<1.0	1,4-Dichlorobenzene	<0.50
Bromodichloromethane	<1.0*	n-Butylbenzene	<1.0
Dibromomethane	<1.0	1,2-Dichlorobenzene	<1.0
Toluene	<1.0	1,2-Dibromo-3-Chloropropane	<1.0
1,1,2-Trichloroethane	<1.0	1,2,4-Trichlorobenzene	<1.0
Tetrachloroethene	<0.50	Hexachlorobutadiene	<1.0
1,3-Dichloropropane	<1.0	Naphthalene	<1.0
Dibromochloromethane	<1.0	1,2,3-Trichlorobenzene	<1.0
1,2-Dibromoethane	<1.0	cis-1,3-Dichloropropene	<1.0
Chlorobenzene	<1.0	trans-1,3-Dichloropropene	<1.0

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA method 502.2

*Present but less than the practical quantitation limit.

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Billy Pratt
2727 Airport Road
Helena, MT 59601

LAB NO.: 89-20182
DATE: 11/27/89 dya

7mw

WATER ANALYSIS

Helena Landfill
HL-8911-003

Sampled 11/11/89 @ 1755
Submitted 11/14/89



<u>Volatile Organic Constituent</u>	<u>µg/l</u>	<u>Volatile Organic Constituent</u>	<u>µg/l</u>
Dichlorodifluoromethane	16	1,1,1,2-Tetrachloroethane	<1.0
Chloromethane	<1.0	Ethylbenzene	<1.0
Vinyl chloride	<0.50	p-Xylene	<1.0
Bromomethane	<1.0	m-Xylene	<1.0
Chloroethane	<1.0	o-Xylene	<1.0
Trichlorofluoromethane	<1.0*	Styrene	<1.0
1,1-Dichloroethene	<0.50	Bromoform	<1.0
Methylene Chloride	1.7	Isopropylbenzene	<1.0
trans-1,2-Dichloroethene	<1.0	1,1,2,2-Tetrachloroethane	<1.0
1,1-Dichloroethane	5.8	Bromobenzene	<1.0
2,2-Dichloropropane	<1.0	1,2,3-Trichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0	n-Propylbenzene	<1.0
Chloroform	2.3	2-Chlorotoluene	<1.0
Bromochloromethane	<1.0	1,3,5-Trimethylbenzene	<1.0
1,1,1-Trichloroethane	7.1	4-Chlorotoluene	<1.0
Carbon Tetrachloride	<0.50	tert-Butylbenzene	<1.0
1,1-Dichloropropene	<1.0	1,2,4-Trimethylbenzene	<1.0
Benzene	<0.50	sec-Butylbenzene	<1.0
1,2-Dichloroethane	<0.50	p-Isopropyltoluene	<1.0
Trichloroethene	3.5	1,3-Dichlorobenzene	<1.0
1,2-Dichloropropane	<1.0	1,4-Dichlorobenzene	<0.50
Bromodichloromethane	<1.0	n-Butylbenzene	<1.0
Dibromomethane	<1.0	1,2-Dichlorobenzene	<1.0
Toluene	<1.0	1,2-Dibromo-3-Chloropropane	<1.0
1,1,2-Trichloroethane	<1.0	1,2,4-Trichlorobenzene	<1.0
Tetrachloroethene	4.5	Hexachlorobutadiene	<1.0
1,3-Dichloropropane	<1.0	Naphthalene	<1.0
Dibromochloromethane	<1.0	1,2,3-Trichlorobenzene	<1.0
1,2-Dibromoethane	<1.0	cis-1,3-Dichloropropene	<1.0
Chlorobenzene	<1.0	trans-1,3-Dichloropropene	<1.0
		Dichloromonofluoromethane	6.3

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA method 502.2

*Present but less than the practical quantitation limit.

LABORATORY REPORT

LAB NO.: 88-20-52
DATE: 11/21/88

TO: [illegible]
ADDRESS: [illegible]
[illegible]

3 M 2

WATER ANALYSIS
Methane Sulfide
ML-2011-002
Sampled 11/1/88 @ 1750
Submitted 11/1/88



Volatile Organic Compounds		Volatile Organic Compounds	
Conc.	Compound	Conc.	Compound
<1.0	1,1,1,2-Tetrachloroethane	18	Dichloromethane
<1.0	Ethylbenzene	<1.0	Chlorobenzene
<1.0	p-Xylene	<0.50	Vinyl chloride
<1.0	m-Xylene	<1.0	Bromobenzene
<1.0	o-Xylene	<1.0	Chloroform
<1.0	Styrene	<1.0	Trichloroethylene
<1.0	Bromobenzene	<0.50	1,1,2,2-Tetrachloroethane
<1.0	Isopropylbenzene	1.7	1,1,2,2-Tetrachloroethane
<1.0	1,1,2,2-Tetrachloroethane	<1.0	Isobutylene oxide
<1.0	Bromobenzene	2.5	trans-1,2-Dichloroethane
<1.0	1,2,3-Trichloropropane	<1.0	1,1-Dichloroethane
<1.0	n-Propylbenzene	<1.0	2,2-Dichloropropane
<1.0	2-Chlorobenzene	2.3	trans-2-Dichloroethane
<1.0	1,2,4-Trimethylbenzene	<1.0	Chlorobenzene
<1.0	4-Chlorobenzene	7.1	Bromochloroethane
<1.0	tert-Butylbenzene	<0.50	1,1,1-Trichloroethane
<1.0	1,2,4-Trimethylbenzene	<1.0	Carbon tetrachloride
<1.0	sec-Butylbenzene	<0.50	1,1-Dichloropropane
<1.0	p-Isopropylbenzene	<0.50	Benzene
<0.50	1,3-Dichlorobenzene	2.5	1,2-Dichloroethane
<1.0	1,4-Dichlorobenzene	<1.0	Trichloroethane
<1.0	n-Butylbenzene	<1.0	1,2-Dichloropropane
<1.0	1,2-Dichlorobenzene	<1.0	Bromochloromethane
<1.0	1,3-Dichloro-2-methylpropane	<1.0	Dichloromethane
<1.0	1,2,4-Trichlorobenzene	<1.0	Toluene
<1.0	Hexachlorobutadiene	<1.0	1,1,2-Trichloroethane
<1.0	Heptachlorene	4.5	Trichloroethane
<1.0	1,2,3-Trichlorobenzene	<1.0	1,2-Dichloropropane
<1.0	cis-1,2-Dichloropropane	<1.0	Dichloromethane
<1.0	trans-1,2-Dichloropropane	<1.0	1,2-Dichloroethane
6.3	Dichloromethane		

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed according with EPA method 821.5

*Present but less than the practical quantitation limit.

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Steve Downs
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-10828
DATE: 05/23/90 dya

WATER ANALYSIS

Helena Landfill

HL-9005-111

Sampled 05/06/90 @ 1135

Submitted 05/08/90

POND ON GOLF COURSE

<u>Volatile Organic Constituent</u>	<u>µg/l</u>	<u>Volatile Organic Constituent</u>	<u>µg/l</u>
Dichlorodifluoromethane	<1.0	1,1,1,2-Tetrachloroethane	<1.0
Chloromethane	<1.0	Ethylbenzene	<1.0
Vinyl chloride	<0.50	p-Xylene	<1.0
Bromomethane	<1.0	m-Xylene	<1.0
Chloroethane	<1.0	o-Xylene	<1.0
Trichlorofluoromethane	<1.0	Styrene	<1.0
1,1-Dichloroethene	<0.50	Bromoform	<1.0
Methylene Chloride	<1.0	Isopropylbenzene	<1.0
trans-1,2-Dichloroethene	<1.0	1,1,2,2-Tetrachloroethane	<1.0
1,1-Dichloroethane	<1.0	Bromobenzene	<1.0
2,2-Dichloropropane	<1.0	1,2,3-Trichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0	n-Propylbenzene	<1.0
Chloroform	<1.0	2-Chlorotoluene	<1.0
Bromochloromethane	<1.0	1,3,5-Trimethylbenzene	<1.0
1,1,1-Trichloroethane	<0.50	4-Chlorotoluene	<1.0
Carbon Tetrachloride	<0.50	tert-Butylbenzene	<1.0
1,1-Dichloropropene	<1.0	1,2,4-Trimethylbenzene	<1.0
Benzene	<0.50	sec-Butylbenzene	<1.0
1,2-Dichloroethane	<0.50	p-Isopropyltoluene	<1.0
Trichloroethene	<0.50	1,3-Dichlorobenzene	<1.0
1,2-Dichloropropane	<1.0	1,4-Dichlorobenzene	<0.50
Bromodichloromethane	<1.0	n-Butylbenzene	<1.0
Dibromomethane	<1.0	1,2-Dichlorobenzene	<1.0
Toluene	<1.0	1,2-Dibromo-3-Chloropropane	<1.0
1,1,2-Trichloroethane	<1.0	1,2,4-Trichlorobenzene	<1.0
Tetrachloroethene	<0.50	Hexachlorobutadiene	<1.0
1,3-Dichloropropane	<1.0	Naphthalene	<1.0
Dibromochloromethane	<1.0	1,2,3-Trichlorobenzene	<1.0
1,2-Dibromoethane	<1.0	cis-1,3-Dichloropropene	<1.0
Chlorobenzene	<1.0	trans-1,3-Dichloropropene	<1.0
		Dichloromonofluoromethane	<1.0

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA Method 502.2

*Present but less than the practical quantitation limit.

COMPLETE ENVIRONMENTAL ANALYTICAL SERVICE

LABORATORY REPORT

LAB NO.: 80-10822
DATE: 05/23/90

TO: Hydramatics
Address: Slave Dams
2727 Wilson Road
Helena, MT 59601

WATER ANALYSIS

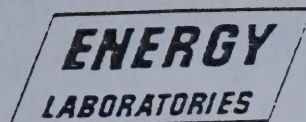
Helena Landfill
HL-9002-111
Sampled 05/18/90 @ 1135
Submitted 05/18/90

Turn on GFCI circuit

Volatiles Organic Compound	mg/L	Volatiles Organic Compound	mg/L
1,1,1-Trichloroethane	<1.0	1,1,1-Trichloroethane	<1.0
Ethylbenzene	<1.0	Ethylbenzene	<1.0
o-Xylene	<1.0	o-Xylene	<1.0
m-Xylene	<1.0	m-Xylene	<1.0
p-Xylene	<1.0	p-Xylene	<1.0
Bromobenzene	<1.0	Bromobenzene	<1.0
Isopropylbenzene	<1.0	Isopropylbenzene	<1.0
1,1,2-Trichloroethane	<1.0	1,1,2-Trichloroethane	<1.0
Bromobenzene	<1.0	Bromobenzene	<1.0
1,2-Dichlorobenzene	<1.0	1,2-Dichlorobenzene	<1.0
n-Propylbenzene	<1.0	n-Propylbenzene	<1.0
2-Chlorotoluene	<1.0	2-Chlorotoluene	<1.0
1,3-Dimethylbenzene	<1.0	1,3-Dimethylbenzene	<1.0
4-Chlorotoluene	<1.0	4-Chlorotoluene	<1.0
tert-Butylbenzene	<1.0	tert-Butylbenzene	<1.0
1,2,4-Triethylbenzene	<1.0	1,2,4-Triethylbenzene	<1.0
sec-Butylbenzene	<1.0	sec-Butylbenzene	<1.0
2-Isopropylbenzene	<1.0	2-Isopropylbenzene	<1.0
1,3-Dichlorobenzene	<0.50	1,3-Dichlorobenzene	<0.50
1,4-Dichlorobenzene	<1.0	1,4-Dichlorobenzene	<1.0
n-Butylbenzene	<1.0	n-Butylbenzene	<1.0
1,2-Dichlorobenzene	<1.0	1,2-Dichlorobenzene	<1.0
1,2-Dibromo-3-Chlorobenzene	<1.0	1,2-Dibromo-3-Chlorobenzene	<1.0
1,2,4-Trichlorobenzene	<1.0	1,2,4-Trichlorobenzene	<1.0
Hexachlorobenzene	<1.0	Hexachlorobenzene	<1.0
Naphthalene	<1.0	Naphthalene	<1.0
1,2,3-Trichlorobenzene	<1.0	1,2,3-Trichlorobenzene	<1.0
cis-1,2-Dichlorobenzene	<1.0	cis-1,2-Dichlorobenzene	<1.0
trans-1,2-Dichlorobenzene	<1.0	trans-1,2-Dichlorobenzene	<1.0
Dichloromethane	<1.0	Dichloromethane	<1.0

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed according to EPA Method 8260.

*Present but less than the practical quantitation limit.
COMPLETE ENVIRONMENTAL ANALYTICAL SERVICE



ENERGY LABORATORIES, INC.

P.O. BOX 30916 • 1107 SOUTH BROADWAY • BILLINGS, MT 59107-0916 • PHONE (406) 252-6325
FAX (406) 252-6069 • 1-800-673-5227

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Randy Huffsmith
2727 Airport Road
Helena, MT 59601LAB NO.: 90-7837
DATE: 04/27/90 dyaWATER ANALYSIS

City of Helena

HL-9004-101

Sampled 04/03/90 @ 1115

Submitted 04/11/90

601 F COURSE well #1

<u>Volatile Organic Constituent</u>	<u>µg/l</u>	<u>Volatile Organic Constituent</u>	<u>µg/l</u>
Dichlorodifluoromethane	1.9	1,1,1,2-Tetrachloroethane	<1.0
Chloromethane	<1.0	Ethylbenzene	<1.0
Vinyl chloride	<0.50	p-Xylene	<1.0
Bromomethane	<1.0	m-Xylene	<1.0
Chloroethane	<1.0	o-Xylene	<1.0
Trichlorofluoromethane	1.4	Styrene	<1.0
1,1-Dichloroethene	<0.50	Bromoform	<1.0
Methylene Chloride	1.9	Isopropylbenzene	<1.0
trans-1,2-Dichloroethene	<1.0	1,1,2,2-Tetrachloroethane	<1.0
1,1-Dichloroethane	<1.0	Bromobenzene	<1.0
2,2-Dichloropropane	<1.0	1,2,3-Trichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0	n-Propylbenzene	<1.0
Chloroform	<1.0*	2-Chlorotoluene	<1.0
Bromochloromethane	<1.0	1,3,5-Trimethylbenzene	<1.0
1,1,1-Trichloroethane	0.96	4-Chlorotoluene	<1.0
Carbon Tetrachloride	<0.50	tert-Butylbenzene	<1.0
1,1-Dichloropropene	<1.0	1,2,4-Trimethylbenzene	<1.0
Benzene	<0.50	sec-Butylbenzene	<1.0
1,2-Dichloroethane	<0.50	p-Isopropyltoluene	<1.0
Trichloroethene	<0.50	1,3-Dichlorobenzene	<1.0
1,2-Dichloropropane	<1.0	1,4-Dichlorobenzene	<0.50
Bromodichloromethane	<1.0	n-Butylbenzene	<1.0
Dibromomethane	<1.0	1,2-Dichlorobenzene	<1.0
Toluene	<1.0	1,2-Dibromo-3-Chloropropane	<1.0
1,1,2-Trichloroethane	<1.0	1,2,4-Trichlorobenzene	<1.0
Tetrachloroethene	1.5	Hexachlorobutadiene	<1.0
1,3-Dichloropropane	<1.0	Naphthalene	<1.0
Dibromochloromethane	<1.0	1,2,3-Trichlorobenzene	<1.0
1,2-Dibromoethane	<1.0	cis-1,3-Dichloropropene	<1.0
Chlorobenzene	<1.0	trans-1,3-Dichloropropene	<1.0

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA method 524.2.

*Present but less than the practical quantitation limit.

LABORATORY REPORT

LAB NO: 88-7837
DATE: 04/27/90

TO: Rensselaer County Health
ADDRESS: 2121 Airport Road
Henrietta, NY 14456

WATER ANALYSIS

City of Henrietta

HL-2004-107

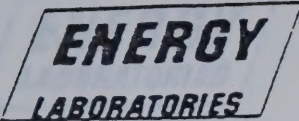
Sampled 04/03/90 @ 1112

Submitted 04/17/90

Self Contained Well #1

Volatiles Organic Compounds	ug/l	Volatiles Organic Compounds	ug/l
1,1,1,2-Tetrachloroethane	<1.0	Dichlorodifluoromethane	1.5
Ethylbenzene	<1.0	Chlorobenzene	<1.0
p-Xylene	<1.0	Vinyl chloride	<0.50
m-Xylene	<1.0	Bromobenzene	<1.0
o-Xylene	<1.0	Chloroethane	<1.0
Styrene	<1.0	1,1-Dichloroethane	1.4
Bromotoluene	<1.0	1,1-Dichloroethane	<0.50
Isopropylbenzene	<1.0	1,1-Dichloroethane	1.9
1,1,2,2-Tetrachloroethane	<1.0	Methylene chloride	<1.0
Bromobenzene	<1.0	trans-1,2-Dichloroethane	<1.0
1,2,3-Trichloropropane	<1.0	1,1-Dichloroethane	<1.0
n-Propylbenzene	<1.0	2,2-Dichloropropane	<1.0
2-Chlorotoluene	<1.0	cis-1,2-Dichloroethane	<1.0
1,2,3-Trimethylbenzene	<1.0	Chloroform	<1.0
4-Chlorotoluene	<1.0	Bromochloromethane	<1.0
tert-Butylbenzene	<1.0	1,1,1-Trichloroethane	0.50
1,2,4-Trimethylbenzene	<1.0	Carbon tetrachloride	<0.50
sec-Butylbenzene	<1.0	1,1-Dichloropropane	<1.0
p-Propyltoluene	<1.0	Benzene	<0.50
1,3-Dichlorobenzene	<0.50	1,2-Dichloroethane	<0.50
1,4-Dichlorobenzene	<1.0	Trichloroethene	<1.0
n-Butylbenzene	<1.0	1,2-Dichloropropane	<1.0
1,2-Dichloroethane	<1.0	Bromodichloroethane	<1.0
1,2-Dibromo-3-Chloropropane	<1.0	Dibromomethane	<1.0
1,2,4-Trichlorobenzene	<1.0	Toluene	<1.0
Hexachlorobutadiene	<1.0	1,1,2-Trichloroethane	<1.0
Naphthalene	<1.0	1,2-Dichloroethane	1.5
1,2,3-Trichlorobenzene	<1.0	1,3-Dichloropropane	<1.0
cis-1,2-Dichloroethane	<1.0	Bromodichloroethane	<1.0
trans-1,2-Dichloroethane	<1.0	1,2-Dichlorobenzene	<1.0

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed according to EPA method 824.2.
*Pressure not less than the practical quantitation limit.



ENERGY LABORATORIES, INC.

P.O. BOX 30916 • 1107 SOUTH BROADWAY • BILLINGS, MT 59107-0916 • PHONE (406) 252-6325
FAX (406) 252-6069 • 1-800-873-5227

LABORATORY REPORT

PAGE : 1

To : Hydrometrics
Address : Attn: Randy Huffsmith
2727 Airport Road
Helena, MT 59601

Lab No. : 90-7837
Date : 4/27/90

WATER ANALYSIS REPORT

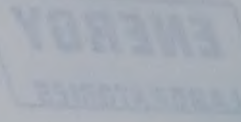
Sample Pt Name : HL-9004-101
Sample Date : 4/ 3/90
Sample Time : 11:15:00
Sample Received : 4/11/90
City of Helena

GOLF COURSE well #1

LABORATORY DATA:

Potassium, Dissolved	----- (mg/l) -----	3
Sodium, Dissolved	----- (mg/l) -----	43
Calcium, Dissolved	----- (mg/l) -----	85
Magnesium, Dissolved	----- (mg/l) -----	26
Sulfate as SO ₄	----- (mg/l) -----	104
Chloride	----- (mg/l) -----	35
Carbonate as CO ₃	----- (mg/l) -----	0
Carbonate as HCO ₃	----- (mg/l) -----	302
Total Hardness as CaCO ₃	----- (mg/l) -----	321
Conductivity, @ 25 degrees C	----- (umhos/cm) -----	767
pH @ 25 degrees C, s.u.	----- (s.u.) -----	7.4
Nitrate + Nitrite as N	----- (mg/l) -----	4.70
Cadmium, Dissolved	----- (mg/l) -----	<0.001
Copper, Dissolved	----- (mg/l) -----	<0.01
Lead, Dissolved	----- (mg/l) -----	<0.01
Iron, Dissolved	----- (mg/l) -----	<0.03
Zinc, Dissolved	----- (mg/l) -----	0.02

cc:



ENERGY LABORATORIES, INC.

PO BOX 2096 • 100 SOUTH BROADWAY • BRIDGEVIEW, NJ 07003 • PHONE (201) 261-1234
FAX (201) 261-1235

LABORATORY REPORT

PAGE : 1

Lab No. : 90-7887
Date : 6/20/90

To :
Address :
City :
State :
Zip :

WATER ANALYSIS REPORT
Sample Name :
Sample Date :
Sample Time :
Sample Received :
City of Origin :
Golf Course Mail #

ANALYST DATA	
Potassium, Dissolved	(mg/l)
Sodium, Dissolved	(mg/l)
Calcium, Dissolved	(mg/l)
Magnesium, Dissolved	(mg/l)
Sulfate as SO ₄	(mg/l)
Chloride	(mg/l)
Carbonate as CO ₃	(mg/l)
Acetate as HCO ₃	(mg/l)
Total Hardness as CaCO ₃	(mg/l)
Hardness, 0.12 degrees C	(mg/l)
PH & 25 degrees C, N.E.	(mg/l)
Nitrate -- Nitrate as N	(mg/l)
Calcium, Dissolved	(mg/l)
Copper, Dissolved	(mg/l)
Lead, Dissolved	(mg/l)
Iron, Dissolved	(mg/l)
Zinc, Dissolved	(mg/l)

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Randy Huffsmith
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-12196
DATE: 05/30/90 dya

WATER ANALYSIS

Helena Landfill
HL-9005-116

Sampled 05/08/90 @ 1140
Submitted 05/15/90

GOLF COURSE well #3



<u>Volatile Organic Constituent</u>	<u>µg/l</u>	<u>Volatile Organic Constituent</u>	<u>µg/l</u>
Dichlorodifluoromethane	5.2	1,1,1,2-Tetrachloroethane	<1.0
Chloromethane	<1.0	Ethylbenzene	<1.0
Vinyl chloride	<0.50	p-Xylene	<1.0
Bromomethane	<1.0	m-Xylene	<1.0
Chloroethane	<1.0	o-Xylene	<1.0
Trichlorofluoromethane	<1.0*	Styrene	<1.0
1,1-Dichloroethene	<0.50*	Bromoform	<1.0
Methylene Chloride	1.1	Isopropylbenzene	<1.0
trans-1,2-Dichloroethene	<1.0	1,1,2,2-Tetrachloroethane	<1.0
1,1-Dichloroethane	1.7	Bromobenzene	<1.0
2,2-Dichloropropane	<1.0	1,2,3-Trichloropropane	<1.0
cis-1,2-Dichloroethene	1.1	n-Propylbenzene	<1.0
Chloroform	3.8	2-Chlorotoluene	<1.0
Bromochloromethane	<1.0	1,3,5-Trimethylbenzene	<1.0
1,1,1-Trichloroethane	2.6	4-Chlorotoluene	<1.0
Carbon Tetrachloride	<0.50	tert-Butylbenzene	<1.0
1,1-Dichloropropene	<1.0	1,2,4-Trimethylbenzene	<1.0
Benzene	<0.50	sec-Butylbenzene	<1.0
1,2-Dichloroethane	<0.50	p-Isopropyltoluene	<1.0
Trichloroethene	1.1	1,3-Dichlorobenzene	<1.0
1,2-Dichloropropane	<1.0	1,4-Dichlorobenzene	<0.50
Bromodichloromethane	<1.0	n-Butylbenzene	<1.0
Dibromomethane	<1.0	1,2-Dichlorobenzene	<1.0
Toluene	<1.0	1,2-Dibromo-3-Chloropropane	<1.0
1,1,2-Trichloroethane	<1.0	1,2,4-Trichlorobenzene	<1.0
Tetrachloroethene	7.0	Hexachlorobutadiene	<1.0
1,3-Dichloropropane	<1.0	Naphthalene	<1.0
Dibromochloromethane	<1.0	1,2,3-Trichlorobenzene	<1.0
1,2-Dibromoethane	<1.0	cis-1,3-Dichloropropene	<1.0
Chlorobenzene	<1.0	trans-1,3-Dichloropropene	<1.0
		Dichloromonofluoromethane	3.9

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA Method 502.2.

*Present but less than the practical quantitation limit.

LABORATORY REPORT

LAB NO: 90-12/88
DATE: 02/20/90

TO:
FROM:
ADDRESS:
CITY:
STATE:
ZIP: 08801

WATER ANALYSIS

Sampled 02/02/90 @ 1740
Submitted 02/12/90
Lab. No. 90-12/88

Volatiles Organic Constituents	mg/l	Volatiles Organic Constituents	mg/l
1,1,2-Trichloroethane	<1.0	1,1,2-Trichloroethane	<1.0
Ethylbenzene	<1.0	Ethylbenzene	<1.0
p-Xylene	<1.0	p-Xylene	<1.0
m-Xylene	<1.0	m-Xylene	<1.0
o-Xylene	<1.0	o-Xylene	<1.0
Styrene	<1.0	Styrene	<1.0
Bromobenzene	<1.0	Bromobenzene	<1.0
Isopropylbenzene	<1.0	Isopropylbenzene	<1.0
1,1,2,2-Tetrachloroethane	<1.0	1,1,2,2-Tetrachloroethane	<1.0
Benzene	<1.0	Benzene	<1.0
1,2,3-Trichlorobenzene	<1.0	1,2,3-Trichlorobenzene	<1.0
n-Propylbenzene	<1.0	n-Propylbenzene	<1.0
2-Chlorotoluene	<1.0	2-Chlorotoluene	<1.0
1,2,4-Trimethylbenzene	<1.0	1,2,4-Trimethylbenzene	<1.0
4-Chlorotoluene	<1.0	4-Chlorotoluene	<1.0
Isobutylbenzene	<1.0	Isobutylbenzene	<1.0
1,2,4-Trimethylbenzene	<1.0	1,2,4-Trimethylbenzene	<1.0
sec-Butylbenzene	<1.0	sec-Butylbenzene	<1.0
p-Propyltoluene	<1.0	p-Propyltoluene	<1.0
1,3-Dichlorobenzene	<1.0	1,3-Dichlorobenzene	<1.0
1,4-Dichlorobenzene	<1.0	1,4-Dichlorobenzene	<1.0
n-Butylbenzene	<1.0	n-Butylbenzene	<1.0
1,2-Dichlorobenzene	<1.0	1,2-Dichlorobenzene	<1.0
1,3-Dichloro-2-Chloropropane	<1.0	1,3-Dichloro-2-Chloropropane	<1.0
1,2,4-Trichlorobenzene	<1.0	1,2,4-Trichlorobenzene	<1.0
Hexachlorobutadiene	<1.0	Hexachlorobutadiene	<1.0
Heptachlorene	<1.0	Heptachlorene	<1.0
1,2,3-Trichlorobenzene	<1.0	1,2,3-Trichlorobenzene	<1.0
cis-1,2-Dichloropropane	<1.0	cis-1,2-Dichloropropane	<1.0
trans-1,2-Dichloropropane	<1.0	trans-1,2-Dichloropropane	<1.0
Dichloromethane	<1.0	Dichloromethane	<1.0

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed according to EPA Method 821.2.

*Present but less than the practical quantitation limit.

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Billy Pratt
2727 Airport Road
Helena, MT 59601

LAB NO.: 89-20181
DATE: 11/27/89 dya

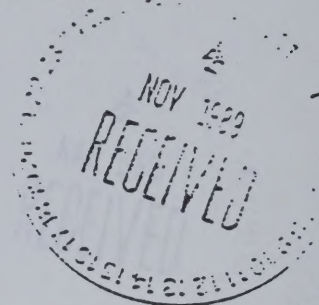
82-2

WATER ANALYSIS

Helena Landfill
HL-8911-002

Sampled 11/11/89 @ 1715

Submitted 11/14/89



<u>Volatile Organic Constituent</u>	<u>µg/l</u>	<u>Volatile Organic Constituent</u>	<u>µg/l</u>
Dichlorodifluoromethane	<1.0	1,1,1,2-Tetrachloroethane	<1.0
Chloromethane	<1.0	Ethylbenzene	<1.0
Vinyl chloride	<0.50	p-Xylene	<1.0
Bromomethane	<1.0	m-Xylene	<1.0
Chloroethane	<1.0	o-Xylene	<1.0
Trichlorofluoromethane	<1.0	Styrene	<1.0
1,1-Dichloroethene	<0.50	Bromoform	<1.0
Methylene Chloride	<1.0	Isopropylbenzene	<1.0
trans-1,2-Dichloroethene	<1.0	1,1,2,2-Tetrachloroethane	<1.0
1,1-Dichloroethane	<1.0	Bromobenzene	<1.0
2,2-Dichloropropane	<1.0	1,2,3-Trichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0	n-Propylbenzene	<1.0
Chloroform	<1.0	2-Chlorotoluene	<1.0
Bromochloromethane	<1.0	1,3,5-Trimethylbenzene	<1.0
1,1,1-Trichloroethane	<0.50	4-Chlorotoluene	<1.0
Carbon Tetrachloride	<0.50	tert-Butylbenzene	<1.0
1,1-Dichloropropene	<1.0	1,2,4-Trimethylbenzene	<1.0
Benzene	<0.50	sec-Butylbenzene	<1.0
1,2-Dichloroethane	<0.50	p-Isopropyltoluene	<1.0
Trichloroethene	<0.50	1,3-Dichlorobenzene	<1.0
1,2-Dichloropropane	<1.0	1,4-Dichlorobenzene	<0.50
Bromodichloromethane	<1.0	n-Butylbenzene	<1.0
Dibromomethane	<1.0	1,2-Dichlorobenzene	<1.0
Toluene	<1.0	1,2-Dibromo-3-Chloropropane	<1.0
1,1,2-Trichloroethane	<1.0	1,2,4-Trichlorobenzene	<1.0
Tetrachloroethene	<0.50	Hexachlorobutadiene	<1.0
1,3-Dichloropropane	<1.0	Naphthalene	<1.0
Dibromochloromethane	<1.0	1,2,3-Trichlorobenzene	<1.0
1,2-Dibromoethane	<1.0	cis-1,3-Dichloropropene	<1.0
Chlorobenzene	<1.0	trans-1,3-Dichloropropene	<1.0

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed accordance with EPA method 502.2

*Present but less than the practical quantitation limit.

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Randy Huffsmith
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-12199
DATE: 05/30/90 dya

WATER ANALYSIS

Helena Landfill
HL-9005-122
Sampled 05/11/90 @ 1530
Submitted 05/15/90

82-4

MAY 1990
RECEIVED

EPA METHOD 625:

<u>Acid Extractables</u>	<u>µg/l</u>		<u>µg/l</u>
4-Chloro-3-methylphenol	<10	2-Nitrophenol	<10
2-Chlorophenol	<10	4-Nitrophenol	<50
2,4-Dichlorophenol	<10	Pentachlorophenol	<50
2,4-Dimethylphenol	<10	Phenol	<10
2,4-Dinitrophenol	<50	2,4,6-Trichlorophenol	<10
2-Methyl-4,6-dinitrophenol	<50		
<u>Base Neutral Extractables</u>	<u>µg/l</u>		<u>µg/l</u>
Acenaphthene	<10	3,3-Dichlorobenzidine	<10
Acenaphthylene	<10	Diethyl phthalate	<10
Anthracene	<10	Dimethyl phthalate	<10
Azobenzene	<10	Di-n-butyl phthalate	<10
Benzidine	<10	2,4-Dinitrotoluene	<10
Benzo(a)anthracene	<10	2,6-Dinitrotoluene	<10
Benzo(a)pyrene	<10	Di-n-octyl phthalate	<10
Benzo(b)fluoranthene	<10	Fluoranthene	<10
Benzo(k)fluoranthene	<10	Fluorene	<10
Benzo(ghi)perylene	<10	Hexachlorobenzene	<10
Bis(2-chloroethoxy)methane	<10	Hexachlorobutadiene	<10
Bis(2-chloroethyl)ether	<10	Hexachloroethane	<10
Bis(2-chloroisopropyl)ether	<10	Indeno (1,2,3-cd)pyrene	<10
Bis(2-ethylhexyl)phthalate	<10	Isophorone	<10
4-Bromophenylphenyl ether	<10	Naphthalene	<10
Butyl benzyl phthalate	<10	Nitrobenzene	<10
2-Chloronaphthalene	<10	N-Nitrosophenylamine	<10
4-Chlorophenylphenyl ether	<10	N-Nitrosodi-n-propylamine	<10
Chrysene	<10	Phenanthrene	<10
Dibenzo(a,h)anthracene	<10	Pyrene	<10
1,2-Dichlorobenzene	<10	1,2,4-Trichlorobenzene	<10
1,3-Dichlorobenzene	<10		
1,4-Dichlorobenzene	<10		

LABORATORY REPORT

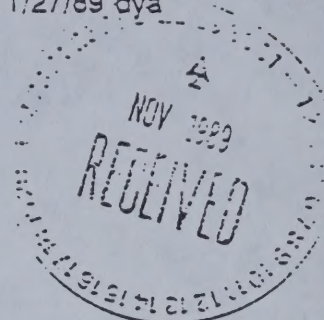
TO: Hydrometrics
ADDRESS: Billy Pratt
2727 Airport Road
Helena, MT 59601

LAB NO.: 89-20180 dup
DATE: 11/27/89 dya

82-4

QUALITY ASSURANCE - DUPLICATE ANALYSIS

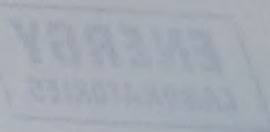
Helena Landfill
HL-8911-001
Sampled 11/11/89 @ 1530
Submitted 11/14/89



<u>Volatile Organic Constituent</u>	<u>µg/l</u>	<u>Volatile Organic Constituent</u>	<u>µg/l</u>
Dichlorodifluoromethane	67	1,1,1,2-Tetrachloroethane	<1.0
Chloromethane	<1.0	Ethylbenzene	<1.0
Vinyl chloride	<0.50	p-Xylene	<1.0
Bromomethane	<1.0	m-Xylene	<1.0
Chloroethane	<1.0	o-Xylene	<1.0
Trichlorofluoromethane	40	Styrene	<1.0
1,1-Dichloroethene	<0.50*	Bromoform	<1.0
Methylene Chloride	7.5	Isopropylbenzene	<1.0
trans-1,2-Dichloroethene	<1.0	1,1,2,2-Tetrachloroethane	<1.0
1,1-Dichloroethane	2.4	Bromobenzene	<1.0
2,2-Dichloropropane	<1.0	1,2,3-Trichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0*	n-Propylbenzene	<1.0
Chloroform	<1.0*	2-Chlorotoluene	<1.0
Bromochloromethane	<1.0	1,3,5-Trimethylbenzene	<1.0
1,1,1-Trichloroethane	9.8	4-Chlorotoluene	<1.0
Carbon Tetrachloride	<0.50	tert-Butylbenzene	<1.0
1,1-Dichloropropene	<1.0	1,2,4-Trimethylbenzene	<1.0
Benzene	<0.50	sec-Butylbenzene	<1.0
1,2-Dichloroethane	<0.50	p-Isopropyltoluene	<1.0
Trichloroethene	2.9	1,3-Dichlorobenzene	<1.0
1,2-Dichloropropane	<1.0	1,4-Dichlorobenzene	<0.50
Bromodichloromethane	<1.0	n-Butylbenzene	<1.0
Dibromomethane	<1.0	1,2-Dichlorobenzene	<1.0
Toluene	<1.0	1,2-Dibromo-3-Chloropropane	<1.0
1,1,2-Trichloroethane	<1.0	1,2,4-Trichlorobenzene	<1.0
Tetrachloroethene	4.8	Hexachlorobutadiene	<1.0
1,3-Dichloropropane	<1.0	Naphthalene	<1.0
Dibromochloromethane	<1.0	1,2,3-Trichlorobenzene	<1.0
1,2-Dibromoethane	<1.0	cis-1,3-Dichloropropene	<1.0
Chlorobenzene	<1.0	trans-1,3-Dichloropropene	<1.0
		Dichloromonofluoromethane	33

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA method 502.2

*Present but less than the practical quantitation limit.



ENERGY LABORATORIES, INC.

100 BOX 20012 • 1101 SOUTH BRADSHAW • BILLINGS, MT 59102-0012

LABORATORY REPORT

TO: Hydrometals
Address: 8111 1st
2727 Airport Road
Helena, MT 59601

82-4

QUALITY ASSURANCE - DUPLICATE ANALYSIS
Helena Landfill
HL-8217-001
Sampled 11/1/89 @ 1530
Submitted 11/1/89



Volatile Organic Constituents		Volatile Organic Constituents	
mg/l		mg/l	
<1.0	1,1,1,2-Tetrachloroethane	57	Dichlorodifluoromethane
<1.0	Ethylbenzene	<1.0	Chlorobenzene
<1.0	p-Xylene	<0.50	Vinyl chloride
<1.0	m-Xylene	<1.0	Bromobenzene
<1.0	o-Xylene	<1.0	Chloroethane
<1.0	Styrene	40	Trichloroethylene
<1.0	Bromobenzene	<0.50*	1,1-Dichloroethane
<1.0	Isopropylbenzene	7.5	Methylene chloride
<1.0	1,1,2,2-Tetrachloroethane	<1.0	trans-1,2-Dichloroethane
<1.0	Bromobenzene	2.4	1,1-Dichloroethane
<1.0	1,2,3-Trichloropropane	<1.0	2,2-Dichloropropane
<1.0	n-Propylbenzene	<1.0*	trans-2,3-Dichloropropane
<1.0	2-Chlorotoluene	<1.0*	Chlorobenzene
<1.0	1,3,5-Trimethylbenzene	<1.0	Bromochloroethane
<1.0	4-Chlorotoluene	8.8	1,1,1-Trichloroethane
<1.0	tert-Butylbenzene	<0.50	Carbon tetrachloride
<1.0	1,2,4-Trimethylbenzene	<1.0	1,1-Dichloropropane
<1.0	sec-Butylbenzene	<0.50	Benzene
<1.0	p-Isopropyltoluene	<0.50	1,2-Dichlorobenzene
<0.50	1,3-Dichlorobenzene	2.9	Trichlorobenzene
<1.0	1,4-Dichlorobenzene	<1.0	1,2-Dichloropropane
<1.0	n-Butylbenzene	<1.0	Bromochloroethane
<1.0	1,2-Dichlorobenzene	<1.0	Dichloromethane
<1.0	1,3-Dichloro-3-Chloropropane	<1.0	Toluene
<1.0	1,2,4-Trichlorobenzene	<1.0	1,1,2-Trichloroethane
<1.0	Hexachlorocyclopentadiene	4.8	Trichloroethylene
<1.0	Naphthalene	<1.0	1,2-Dichloropropane
<1.0	1,2,3-Trichlorobenzene	<1.0	Dichlorodifluoromethane
<1.0	cis-1,2-Dichloropropane	<1.0	1,2-Dichloroethane
<1.0	trans-1,2-Dichloropropane	<1.0	Chlorobenzene
32	Dichlorodifluoromethane		

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed according to EPA method 800.2

*Present but less than the practical quantitation limit.

ANALYTICAL SERVICES - WATER, SOIL, PETROLEUM, COAL

**ENERGY
LABORATORIES**
ENERGY LABORATORIES, INC.

 P.O. BOX 30916 • 1107 SOUTH BROADWAY • BILLINGS, MT 59107-0916 • PHONE (406) 252-6325
 FAX (406) 252-6069 • 1-800-873-5227

LABORATORY REPORT

PAGE : 1

 To : Hydrometrics
 Address : Attn: Steve Downs
2727 Airport Road
Helena, MT 59601

 Lab No. : 91-12769
 Date : 6/21/91
WATER ANALYSIS REPORT

 Sample Pt Name : HL9104-106
 Sample Date : 4/ 5/91
 Sample Time : 14:00:00
 Sample Received : 4/ 9/91

Helena Landfill

 PHASE 1-Volatile Organic Constituents
 EPA Method 624, Revised 06/21/91

LABORATORY DATA:

Acetone-----	(ug/l)----	<10
Acrolein-----	(ug/l)----	<10
Acrylonitrile-----	(ug/l)----	<10
Benzene-----	(ug/l)----	<0.50
Bromochloromethane-----	(ug/l)----	<1.0
1,1-Dichloromethane-----	(ug/l)----	<1.0
cis-1,3-Dichloropropene-----	(ug/l)----	<1.0
trans-1,3-Dichloropropene-----	(ug/l)----	<1.0
1,4-Difluorobenzene-----	(ug/l)----	<10
Ethanol-----	(mg/l)----	<10
Ethylbenzene-----	(ug/l)----	<1.0
Ethyl methacrylate-----	(ug/l)----	<10
4-Bromofluorobenzene-----	(ug/l)----	<1.0
Bromoform-----	(ug/l)----	<1.0
Bromomethane-----	(ug/l)----	<10
2-Butanone(Methyl Ethyl Ketone)-----	(ug/l)----	<10
Carbon disulfide-----	(ug/l)----	<0.50
Carbon Tetrachloride-----	(ug/l)----	<1.0
Chlorobenzene-----	(ug/l)----	<1.0
Dibromochloromethane-----	(ug/l)----	<1.0
Chloroethane-----	(ug/l)----	<10
2-Chloroethylvinyl ether-----	(ug/l)----	3.2
Chloroform-----	(ug/l)----	<1.0
Chloromethane-----	(ug/l)----	<1.0
Dibromomethane-----	(ug/l)----	<10
1,4-Dichloro-2-butene-----	(ug/l)----	<1.0
Dichlorodifluoromethane-----	(ug/l)----	<1.0
1,1-Dichloroethane-----	(ug/l)----	<0.50
1,2-Dichloroethane-----	(ug/l)----	<10
2-Hexanone-----	(ug/l)----	<10
Iodomethane-----	(ug/l)----	<1.0
Ethylene Chloride-----	(ug/l)----	<10
Methyl-2-pentanone-----	(ug/l)----	<0.50
1,1-Dichloroethene-----	(ug/l)----	<1.0
trans-1,2-Dichloroethene-----	(ug/l)----	<1.0

LABORATORY REPORT

PAGE : 2

To : Hydrometrics
Address : Attn: Steve Downs
2727 Airport Road
Helena, MT 59601

Lab No. : 91-12769
Date : 6/21/91

WATER ANALYSIS REPORT

Sample Pt Name : HL9104-106
Sample Date : 4/ 5/91
Sample Time : 14:00:00
Sample Received : 4/ 9/91

Helena Landfill

PHASE 1-Volatile Organic Constituents
EPA Method 624, Revised 06/21/91

LABORATORY DATA:

Styrene-----	(ug/l)----	<1.0
1,1,2,2-Tetrachloroethane-----	(ug/l)----	<1.0
Toluene-----	(ug/l)----	<1.0
1,1,1-Trichloroethane-----	(ug/l)----	2.9
1,1,2-Trichloroethane-----	(ug/l)----	<1.0
Dichloroethene-----	(ug/l)----	<0.50
Dichlorofluoromethane-----	(ug/l)----	<1.0
1,2,3-Trichloropropane-----	(ug/l)----	<1.0
Vinyl acetate-----	(ug/l)----	<10
Vinyl chloride-----	(ug/l)----	<0.50
Xylenes-----	(ug/l)----	<1.0
Tetrachloroethene-----	(ug/l)----	<0.50

cc:

**ENERGY
LABORATORIES**
ENERGY LABORATORIES, INC.

 P.O. BOX 30916 • 1107 SOUTH BROADWAY • BILLINGS, MT 59107-0916 • PHONE (406) 252-6325
 FAX (406) 252-6069 • 1-800-873-5227

LABORATORY REPORT

PAGE : 1

 To : Hydrometrics
 Address : Attn: Steve Downs
2727 Airport Road
Helena, MT 59061

 Lab No. : 91-12769
 Date : 4/24/91
WATER ANALYSIS REPORT

 Sample Pt Name : HL9104-106
 Sample Date : 4/ 5/91
 Sample Time : 14:00:00
 Sample Received : 4/ 9/91
Helena Landfill
LABORATORY DATA:

Potassium, Dissolved-----	(mg/l)----	5
Sodium, Dissolved-----	(mg/l)----	23
Calcium, Dissolved-----	(mg/l)----	114
Magnesium, Dissolved-----	(mg/l)----	31
Sulfate as SO4-----	(mg/l)----	109
Chloride-----	(mg/l)----	32
Carbonate as CO3-----	(mg/l)----	0
Carbonate as HCO3-----	(mg/l)----	311
Acids, Dissolved @ 180 degrees C-----	(mg/l)----	511
Alkalinity, Total as CaCO3, pH 4.5-----	(mg/l)----	255
pH @ 25 degrees C, s.u.-----	(s.u.)----	7.5
Nitrate + Nitrite as N-----	(mg/l)----	8.91
Nitrogen, Ammonia-----	(mg/l)----	<0.1
Chemical Oxygen Demand-----	(mg/l)----	<1
Organic Carbon, Total-----	(mg/l)----	<2
Cyanide, Total-----	(mg/l)----	<0.005
Arsenic, Dissolved-----	(mg/l)----	<0.005
Barium, Dissolved-----	(mg/l)----	<0.1
Cadmium, Dissolved-----	(mg/l)----	<0.001
Chromium, Dissolved-----	(mg/l)----	<0.02
Iron, Dissolved-----	(mg/l)----	<0.03
Lead, Dissolved-----	(mg/l)----	<0.01
Manganese, Dissolved-----	(mg/l)----	0.04
Mercury, Dissolved-----	(mg/l)----	<0.001
Selenium, Dissolved-----	(mg/l)----	<0.005
Silver, Dissolved-----	(mg/l)----	<0.005

cc:

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Billy Pratt
2727 Airport Road
Helena, MT 59601

LAB NO.: 89-20183
DATE: 11/27/89 dya

83-7

WATER ANALYSIS

Helena Landfill
HL-8911-004

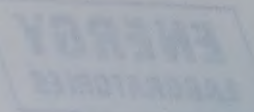
Sampled 11/11/89 @ 1855
Submitted 11/14/89



<u>Volatile Organic Constituent</u>	<u>µg/l</u>	<u>Volatile Organic Constituent</u>	<u>µg/l</u>
Dichlorodifluoromethane	<1.0*	1,1,1,2-Tetrachloroethane	<1.0
Chloromethane	<1.0	Ethylbenzene	<1.0
Vinyl chloride	<0.50	p-Xylene	<1.0
Bromomethane	<1.0	m-Xylene	<1.0
Chloroethane	<1.0	o-Xylene	<1.0
Trichlorofluoromethane	<1.0	Styrene	<1.0
1,1-Dichloroethene	<0.50	Bromoform	<1.0
Methylene Chloride	<1.0*	Isopropylbenzene	<1.0
trans-1,2-Dichloroethene	<1.0	1,1,2,2-Tetrachloroethane	<1.0
1,1-Dichloroethane	<1.0*	Bromobenzene	<1.0
2,2-Dichloropropane	<1.0	1,2,3-Trichloropropane	<1.0
cis-1,2-Dichloroethene	4.4	n-Propylbenzene	<1.0
Chloroform	<1.0	2-Chlorotoluene	<1.0
Bromochloromethane	<1.0	1,3,5-Trimethylbenzene	<1.0
1,1,1-Trichloroethane	<0.50	4-Chlorotoluene	<1.0
Carbon Tetrachloride	<0.50	tert-Butylbenzene	<1.0
1,1-Dichloropropene	<1.0	1,2,4-Trimethylbenzene	<1.0
Benzene	<0.50	sec-Butylbenzene	<1.0
1,2-Dichloroethane	<0.50	p-Isopropyltoluene	<1.0
Trichloroethene	<0.50	1,3-Dichlorobenzene	<1.0
1,2-Dichloropropane	<1.0	1,4-Dichlorobenzene	<0.50
Bromodichloromethane	<1.0	n-Butylbenzene	<1.0
Dibromomethane	<1.0	1,2-Dichlorobenzene	<1.0
Toluene	<1.0	1,2-Dibromo-3-Chloropropane	<1.0
1,1,2-Trichloroethane	<1.0	1,2,4-Trichlorobenzene	<1.0
Tetrachloroethene	<0.50	Hexachlorobutadiene	<1.0
1,3-Dichloropropane	<1.0	Naphthalene	<1.0
Dibromochloromethane	<1.0	1,2,3-Trichlorobenzene	<1.0
1,2-Dibromoethane	<1.0	cis-1,3-Dichloropropene	<1.0
Chlorobenzene	<1.0	trans-1,3-Dichloropropene	<1.0
		Dichloromonofluoromethane	<1.0*

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA method 502.2

*Present but less than the practical quantitation limit.



ENERGY LABORATORIES, INC.
40 BOX 20416 • 1010 SOUTH BROADWAY • BILLINGS, MT 59101-0416 • PHONE (406) 245-8322
FAX (406) 245-8323

LABORATORY REPORT

LAB NO.: 88-20183
DATE: 11/21/88 gys

TO: Hydrocarbons
ADDRESS: Gary Pelt
2727 Airport Road
Helena, MT 59601

83-7

WATER ANALYSIS

Helena Landfill
HL-8811-004
Sampled 11/1/88 @ 1825
Submitted 11/1/88



Volatile Organic Constituents		Volatile Organic Constituents	
ug/l		ug/l	
<1.0	1,1,2,2-Tetrachloroethane	<1.0	Dichloromethane
<1.0	Ethylbenzene	<1.0	Chlorobenzene
<1.0	p-Xylene	<0.50	Vinyl chloride
<1.0	m-Xylene	<1.0	Bromobenzene
<1.0	o-Xylene	<1.0	Chloroethane
<1.0	Styrene	<1.0	Trichloroethylene
<1.0	Benzotoluene	<0.50	1,1-Dichloroethane
<1.0	Isopropylbenzene	<1.0	Methyl ethyl ketone
<1.0	1,1,2,2-Tetrachloroethane	<1.0	trans-1,2-Dichloroethane
<1.0	Bromobenzene	<1.0	1,1-Dichloroethane
<1.0	1,2,3-Trichlorobenzene	<1.0	2,3-Dichlorobenzene
<1.0	n-Propylbenzene	4.4	cis-1,2-Dichlorobenzene
<1.0	2-Chlorotoluene	<1.0	Chloroform
<1.0	1,2,3-Trimethylbenzene	<1.0	Bromochloroethane
<1.0	4-Chlorotoluene	<0.50	1,1,1-Trichloroethane
<1.0	Isobutylbenzene	<0.50	Carbon tetrachloride
<1.0	1,2,4-Trimethylbenzene	<1.0	1,1-Dichloropropane
<1.0	sec-Butylbenzene	<0.50	Benzene
<1.0	p-Isopropyltoluene	<0.50	1,2-Dichlorobenzene
<1.0	1,3-Dichlorobenzene	<0.50	Thionolene
<0.50	1,4-Dichlorobenzene	<1.0	1,2-Dichloropropane
<1.0	n-Butylbenzene	<1.0	Bromodichloromethane
<1.0	1,2-Dichlorobenzene	<1.0	Dichloromethane
<1.0	1,2-Dibromo-3-Chloropropane	<1.0	Toluene
<1.0	1,2,4-Trichlorobenzene	<1.0	1,1,2-Trichlorobenzene
<1.0	Hexachlorobutadiene	<0.50	Tetrachloroethane
<1.0	Naphthalene	<1.0	1,2-Dichloropropane
<1.0	1,2,3-Trichlorobenzene	<1.0	Dibromochloromethane
<1.0	cis-1,2-Dichloropropene	<1.0	1,2-Dichloroethane
<1.0	trans-1,2-Dichloropropene	<1.0	Chlorobenzene
<1.0	Dichloromethylmethane		

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed according with EPA method 802.2

*Present but less than the practical quantitation limit

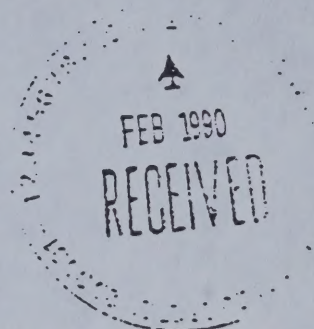
TO: Hydrometrics
ADDRESS: Randy Huffsmith
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-2766
DATE: 02/09/90 dya

WATER ANALYSIS

Helena Landfill
HL90-2-101
Sampled 02/02/90 @ 1615
Submitted 02/06/90

HL9C-1



<u>Volatile Organic Constituent</u>	<u>µg/l</u>	<u>Volatile Organic Constituent</u>	<u>µg/l</u>
Dichlorodifluoromethane	15.0	1,1,1,2-Tetrachloroethane	<1.0
Chloromethane	<1.0	Ethylbenzene	<1.0
Vinyl chloride	<0.50	p-Xylene	<1.0
Bromomethane	<1.0	m-Xylene	<1.0
Chloroethane	<1.0	o-Xylene	<1.0
Trichlorofluoromethane	<1.0	Styrene	<1.0
1,1-Dichloroethene	<0.50*	Bromoform	<1.0
Methylene Chloride	3.6	Isopropylbenzene	<1.0
trans-1,2-Dichloroethene	<1.0	1,1,2,2-Tetrachloroethane	<1.0
1,1-Dichloroethane	2.6	Bromobenzene	<1.0
2,2-Dichloropropane	<1.0	1,2,3-Trichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0*	n-Propylbenzene	<1.0
Chloroform	3.5	2-Chlorotoluene	<1.0
Bromochloromethane	<1.0	1,3,5-Trimethylbenzene	<1.0
1,1,1-Trichloroethane	7.4	4-Chlorotoluene	<1.0
Carbon Tetrachloride	<0.50	tert-Butylbenzene	<1.0
1,1-Dichloropropene	<1.0	1,2,4-Trimethylbenzene	<1.0
Benzene	<0.50	sec-Butylbenzene	<1.0
1,2-Dichloroethane	0.58	p-Isopropyltoluene	<1.0
Trichloroethene	1.5	1,3-Dichlorobenzene	<1.0
1,2-Dichloropropane	<1.0	1,4-Dichlorobenzene	<0.50
Bromodichloromethane	<1.0	n-Butylbenzene	<1.0
Dibromomethane	<1.0	1,2-Dichlorobenzene	<1.0
Toluene	<1.0	1,2-Dibromo-3-Chloropropane	<1.0
1,1,2-Trichloroethane	<1.0	1,2,4-Trichlorobenzene	<1.0
Tetrachloroethene	13.0	Hexachlorobutadiene	<1.0
1,3-Dichloropropane	<1.0	Naphthalene	<1.0
Dibromochloromethane	<1.0	1,2,3-Trichlorobenzene	<1.0
1,2-Dibromoethane	<1.0	cis-1,3-Dichloropropene	<1.0
Chlorobenzene	<1.0	trans-1,3-Dichloropropene	<1.0
		Dichloromonofluoromethane	6.9

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed accordance with EPA method 502.2.

*Present but less than the practical quantitation limit.

TO: Hydrometals
ADDRESS: Randy Hults
7777 Aspen Road
Havert, MT. 59501

LAS NO.: 90-3768
DATE: 02-09-93

WATER ANALYSIS

Helena Landfill
HL90-2-101
Sampled 02/02/93 @ 1215
Submitted 02/02/93

HLPC-1



Volatle Organic Compound	mg/l	mg/l	Volatle Organic Compound
1,1,1,2-Tetrachloroethane	<1.0	1.50	1,1,1,2-Tetrachloroethane
Ethylbenzene	<1.0	<1.0	Ethylbenzene
p-Xylene	<1.0	<0.50	p-Xylene
m-Xylene	<1.0	<1.0	m-Xylene
o-Xylene	<1.0	<1.0	o-Xylene
Styrene	<1.0	<1.0	Styrene
Bromobenzene	<1.0	<0.50*	Bromobenzene
Isopropylbenzene	<1.0	3.8	Isopropylbenzene
1,1,2,2-Tetrachloroethane	<1.0	<1.0	1,1,2,2-Tetrachloroethane
Bromobenzene	<1.0	3.8	Bromobenzene
1,2,3-Trichloropropane	<1.0	<1.0	1,2,3-Trichloropropane
n-Propylbenzene	<1.0	<1.0*	n-Propylbenzene
2-Chlorobenzene	<1.0	3.8	2-Chlorobenzene
1,3,5-Trimethylbenzene	<1.0	<1.0	1,3,5-Trimethylbenzene
4-Chlorobenzene	<1.0	7.4	4-Chlorobenzene
tert-Butylbenzene	<1.0	<0.50	tert-Butylbenzene
1,2,4-Trimethylbenzene	<1.0	<1.0	1,2,4-Trimethylbenzene
sec-Butylbenzene	<1.0	<0.50	sec-Butylbenzene
p-Propylbenzene	<1.0	0.58	p-Propylbenzene
1,3-Dichlorobenzene	<0.50	1.5	1,3-Dichlorobenzene
1,4-Dichlorobenzene	<1.0	<1.0	1,4-Dichlorobenzene
n-Butylbenzene	<1.0	<1.0	n-Butylbenzene
1,2-Dichloropropane	<1.0	<1.0	1,2-Dichloropropane
1,3-Dichloro-2-Chloropropane	<1.0	<1.0	1,3-Dichloro-2-Chloropropane
1,2,4-Trichlorobenzene	<1.0	<1.0	1,2,4-Trichlorobenzene
Hexachlorobutadiene	<1.0	1.50	Hexachlorobutadiene
Heptachlorene	<1.0	<1.0	Heptachlorene
1,2,3-Trichloropropane	<1.0	<1.0	1,2,3-Trichloropropane
cis-1,2-Dichloropropane	<1.0	<1.0	cis-1,2-Dichloropropane
trans-1,2-Dichloropropane	<1.0	<1.0	trans-1,2-Dichloropropane
Chloromethane	8.9	<1.0	Chloromethane

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed according to EPA method 802.2.

*Present but less than the practical quantitation limit.

ENERGY
LABORATORIES

ENERGY LABORATORIES, INC.

 P.O. BOX 30916 • 1107 SOUTH BROADWAY • BILLINGS MT 59107-0916 • PHONE (406) 252-6325
 800-873-5227

LABORATORY REPORT

PAGE : 1

 To : Hydrometrics
 Address : Attn: Randy Huffsmith
2727 Airport Road
Helena, MT 59601

 Lab No. : 90-2766
 Date : 2/12/90
WATER ANALYSIS REPORT
 Sample Pt Name : HL90-2-101
 Sample Date : 2/ 2/90
 Sample Time : 16:15:00
 Sample Received : 2/ 6/90
 Helena Landfill

HL90-1

LABORATORY DATA:

Potassium, Dissolved-----	(mg/l)----	3
Sodium, Dissolved-----	(mg/l)----	35
Calcium, Dissolved-----	(mg/l)----	137
Magnesium, Dissolved-----	(mg/l)----	45
Sulfate as SO4-----	(mg/l)----	132
Chloride-----	(mg/l)----	31
Carbonate as CO3-----	(mg/l)----	0
Carbonate as HCO3-----	(mg/l)----	482
Acids, Dissolved @ 180 degrees C-----	(mg/l)----	685
Total Hardness as CaCO3-----	(mg/l)----	528
Alkalinity, Total as CaCO3, pH 4.5-----	(mg/l)----	395
Conductivity, @ 25 degrees C-----	(umhos/cm)	1100
pH @ 25 degrees C, s.u.-----	(s.u.)----	7.8
Nitrate + Nitrite as N-----	(mg/l)----	8.40
Cadmium, Dissolved-----	(mg/l)----	0.005
Copper, Dissolved-----	(mg/l)----	<0.01
Iron, Dissolved-----	(mg/l)----	<0.03
Lead, Dissolved-----	(mg/l)----	<0.01
Zinc, Dissolved-----	(mg/l)----	0.02

cc:

 FEB 1990
 RECEIVED

LABORATORY REPORT

LAB NO.: 90-12198
DATE: 05/30/90 dya

WATER ANALYSIS

Helena Landfill
HL-9005-121
Sampled 05/11/90 @ 1110
Submitted 05/15/90

HL-90-1

EPA METHOD 625:

<u>Acid Extractables</u>	<u>µg/l</u>		<u>µg/l</u>
4-Chloro-3-methylphenol	<10	2-Nitrophenol	<10
2-Chlorophenol	<10	4-Nitrophenol	<50
2,4-Dichlorophenol	<10	Pentachlorophenol	<50
2,4-Dimethylphenol	<10	Phenol	<10
2,4-Dinitrophenol	<50	2,4,6-Trichlorophenol	<10
2-Methyl-4,6-dinitrophenol	<50		

Base Neutral Extractables	$\mu\text{g/l}$		$\mu\text{g/l}$
Acenaphthene	<10	3,3-Dichlorobenzidine	<10
Acenaphthylene	<10	Diethyl phthalate	<10
Anthracene	<10	Dimethyl phthalate	<10
Azobenzene	<10	Di-n-butyl phthalate	<10
Benzidine	<10	2,4-Dinitrotoluene	<10
Benzo(a)anthracene	<10	2,6-Dinitrotoluene	<10
Benzo(a)pyrene	<10	Di-n-octyl phthalate	<10
Benzo(b)fluoranthene	<10	Fluoranthene	<10
Benzo(k)fluoranthene	<10	Fluorene	<10
Benzo(ghi)perylene	<10	Hexachlorobenzene	<10
Bis(2-chloroethoxy)methane	<10	Hexachlorobutadiene	<10
Bis(2-chloroethyl)ether	<10	Hexachloroethane	<10
Bis(2-chloroisopropyl)ether	<10	Indeno (1,2,3-cd)pyrene	<10
Bis(2-ethylhexyl)phthalate	<10	Isophorone	<10
4-Bromophenylphenyl ether	<10	Naphthalene	<10
Butyl benzyl phthalate	<10	Nitrobenzene	<10
2-Chloronaphthalene	<10	N-Nitrosophenylamine	<10
4-Chlorophenylphenyl ether	<10	N-Nitrosodi-n-propylamine	<10
Chrysene	<10	Phenanthrene	<10
Dibenzo(a,h)anthracene	<10	Pyrene	<10
1,2-Dichlorobenzene	<10	1,2,4-Trichlorobenzene	<10
1,3-Dichlorobenzene	<10		
1,4-Dichlorobenzene	<10		

LABORATORY REPORT

PAGE : 1

 To : Hydrometrics
 Address : Attn: Steve Downs
2727 Airport Road
Helena, MT 59601

 Lab No. : 91-12771
 Date : 6/21/91
WATER ANALYSIS REPORT

 Sample Pt Name : HL9104-108
 Sample Date : 4/ 5/91
 Sample Time : 15:30:00
 Sample Received : 4/ 9/91

Helena Landfill

 PHASE 1-Volatile Organic Constituents
 EPA Method 624, Revised 06/21/91

LABORATORY DATA:

Acetone-----	(ug/l)----	<10
Acrolein-----	(ug/l)----	<10
Acrylonitrile-----	(ug/l)----	<10
Benzene-----	(ug/l)----	<0.50
Bromochloromethane-----	(ug/l)----	<1.0
Bromodichloromethane-----	(ug/l)----	<1.0
cis-1,3-Dichloropropene-----	(ug/l)----	<1.0
trans-1,3-Dichloropropene-----	(ug/l)----	<1.0
1,4-Difluorobenzene-----	(ug/l)----	<10
Ethanol-----	(mg/l)----	<10
Ethylbenzene-----	(ug/l)----	<1.0
Ethyl methacrylate-----	(ug/l)----	<10
4-Bromofluorobenzene-----	(ug/l)----	<10
Bromoform-----	(ug/l)----	<1.0
Bromomethane-----	(ug/l)----	<1.0
2-Butanone(Methyl Ethyl Ketone)-----	(ug/l)----	<10
Carbon disulfide-----	(ug/l)----	<10
Carbon Tetrachloride-----	(ug/l)----	<0.50
Chlorobenzene-----	(ug/l)----	<1.0
Dibromochloromethane-----	(ug/l)----	<1.0
Chloroethane-----	(ug/l)----	<1.0
2-Chloroethylvinyl ether-----	(ug/l)----	<10
Chloroform-----	(ug/l)----	4.1
Chloromethane-----	(ug/l)----	<1.0
Dibromomethane-----	(ug/l)----	<1.0
1,4-Dichloro-2-butene-----	(ug/l)----	<10
Dichlorodifluoromethane-----	(ug/l)----	8.9
1,1-Dichloroethane-----	(ug/l)----	2.9
1,2-Dichloroethane-----	(ug/l)----	0.50
2-Hexanone-----	(ug/l)----	<10
Iodomethane-----	(ug/l)----	<10
Methylene Chloride-----	(ug/l)----	3.6
Methyl-2-pentanone-----	(ug/l)----	<10
1,1-Dichloroethene-----	(ug/l)----	<0.50*
trans-1,2-Dichloroethene-----	(ug/l)----	<1.0

LABORATORY REPORT

PAGE : 2

To : Hydrometrics
Address : Attn: Steve Downs
2727 Airport Road
Helena, MT 59601

Lab No. : 91-12771
Date : 6/21/91

WATER ANALYSIS REPORT

Sample Pt Name : HL9104-108
Sample Date : 4/ 5/91
Sample Time : 15:30:00
Sample Received : 4/ 9/91

Helena Landfill

PHASE 1-Volatile Organic Constituents
EPA Method 624, Revised 06/21/91

LABORATORY DATA:

Styrene-----	(ug/l)----	<1.0
1,1,2,2-Tetrachloroethane-----	(ug/l)----	<1.0
Toluene-----	(ug/l)----	<1.0
1,1,1-Trichloroethane-----	(ug/l)----	7.0
1,1,2-Trichloroethane-----	(ug/l)----	<1.0
1,1,2-Trichloroethane-----	(ug/l)----	2.2
1,1,2-Trichloroethane-----	(ug/l)----	2.8
1,2,3-Trichloropropane-----	(ug/l)----	<1.0
Vinyl acetate-----	(ug/l)----	<10
Vinyl chloride-----	(ug/l)----	<0.50
Xylenes-----	(ug/l)----	<1.0
Tetrachloroethene-----	(ug/l)----	12

cc:

LABORATORY REPORT

PAGE: 2

Lab No.: 87-10011
Date: 8/22/91

Client: ALBERTA POWER
Project: ALBERTA POWER
Address: 100 BOK BLDG
City: BIRMINGHAM, AL 35203

WATER ANALYSIS REPORT

Sample ID Name: WLS104-108
Sample Date: 8/2/91
Sample Time: 13:30:00
Sample Received: 8/2/91
Reagents (analyte)
Phase I-Volatile Organic Constituents
EPA Method 824, Revised 06/7/91

<1.0
<1.0
<1.0
7.0
<1.0
2.2
2.8
<1.0
<1.0
20.00
<1.0
12

(ug/l)	1,1,1-Trichloroethane
(ug/l)	1,1,2-Trichloroethane
(ug/l)	1,2-Dichloroethane
(ug/l)	1,1-Dichloroethane
(ug/l)	1,1,1-Trichloroethene
(ug/l)	1,1,2-Trichloroethene
(ug/l)	1,2-Dichloroethene
(ug/l)	1,1-Dichloroethene
(ug/l)	1,1,1-Trichloroethane
(ug/l)	1,1,2-Trichloroethane
(ug/l)	1,2-Dichloroethane
(ug/l)	1,1-Dichloroethane
(ug/l)	1,1,1-Trichloroethene
(ug/l)	1,1,2-Trichloroethene
(ug/l)	1,2-Dichloroethene
(ug/l)	1,1-Dichloroethene

LABORATORY REPORT
PAGE : 1

To : Hydrometrics
Address : Attn: Steve Downs
2727 Airport Road
Helena, MT 59061

Lab No. : 91-12771
Date : 4/24/91

WATER ANALYSIS REPORT

Sample Pt Name : HL9104-108
Sample Date : 4/ 5/91
Sample Time : 15:30:00
Sample Received : 4/ 9/91
Helena Landfill

LABORATORY DATA:

Potassium, Dissolved-----	(mg/l)----	5
Sodium, Dissolved-----	(mg/l)----	38
Calcium, Dissolved-----	(mg/l)----	144
Magnesium, Dissolved-----	(mg/l)----	48
Sulfate as SO4-----	(mg/l)----	140
Chloride-----	(mg/l)----	33
Carbonate as CO3-----	(mg/l)----	0
Bicarbonate as HCO3-----	(mg/l)----	491
Slids, Dissolved @ 180 degrees C-----	(mg/l)----	687
Alkalinity, Total as CaCO3, pH 4.5-----	(mg/l)----	402
pH @ 25 degrees C, s.u.-----	(s.u.)----	7.7
Nitrate + Nitrite as N-----	(mg/l)----	7.53
Nitrogen, Ammonia-----	(mg/l)----	<0.1
Chemical Oxygen Demand-----	(mg/l)----	2
Organic Carbon, Total-----	(mg/l)----	<2
Cyanide, Total-----	(mg/l)----	<0.005
Arsenic, Dissolved-----	(mg/l)----	<0.005
Barium, Dissolved-----	(mg/l)----	<0.1
Cadmium, Dissolved-----	(mg/l)----	0.001
Chromium, Dissolved-----	(mg/l)----	<0.02
Iron, Dissolved-----	(mg/l)----	<0.03
Lead, Dissolved-----	(mg/l)----	<0.01
Manganese, Dissolved-----	(mg/l)----	<0.02
Mercury, Dissolved-----	(mg/l)----	<0.001
Selenium, Dissolved-----	(mg/l)----	<0.005
Silver, Dissolved-----	(mg/l)----	<0.005

cc:

LABORATORY REPORT

PAGE : 1

 To : Hydrometrics
 Address : Attn: Steve Downs
2727 Airport Road
Helena, MT 59601

 Lab No. : 91-12772
 Date : 6/21/91
WATER ANALYSIS REPORT

 Sample Pt Name : HL9104-118
 Sample Date : 4/ 5/91
 Sample Time : 16:00:00
 Sample Received : 4/ 9/91

Helena Landfill

 PHASE 1-Volatile Organic Constituents
 EPA Method 624, Revised 06/21/91

LABORATORY DATA:

Acetone-----	(ug/l)----	<10
Acrolein-----	(ug/l)----	<10
Acrylonitrile-----	(ug/l)----	<10
Benzene-----	(ug/l)----	<0.50
Bromochloromethane-----	(ug/l)----	<1.0
Bromodichloromethane-----	(ug/l)----	<1.0
trans-1,3-Dichloropropene-----	(ug/l)----	<1.0
trans-1,3-Dichloropropene-----	(ug/l)----	<1.0
1,4-Difluorobenzene-----	(ug/l)----	<10
Ethanol-----	(ug/l)----	<10
Ethylbenzene-----	(ug/l)----	<1.0
Ethyl methacrylate-----	(ug/l)----	<10
4-Bromofluorobenzene-----	(ug/l)----	<10
Bromoform-----	(ug/l)----	<1.0
Bromomethane-----	(ug/l)----	<1.0
2-Butanone(Methyl Ethyl Ketone)-----	(ug/l)----	<10
Carbon disulfide-----	(ug/l)----	<10
Carbon Tetrachloride-----	(ug/l)----	<0.50
Chlorobenzene-----	(ug/l)----	<1.0
Dibromochloromethane-----	(ug/l)----	<1.0
Chloroethane-----	(ug/l)----	<1.0
2-Chloroethylvinyl ether-----	(ug/l)----	<10
Chloroform-----	(ug/l)----	3.9
Chloromethane-----	(ug/l)----	<1.0
Dibromomethane-----	(ug/l)----	<1.0
1,4-Dichloro-2-butene-----	(ug/l)----	<10
Dichlorodifluoromethane-----	(ug/l)----	8.8
1,1-Dichloroethane-----	(ug/l)----	2.8
1,2-Dichloroethane-----	(ug/l)----	0.50
2-Hexanone-----	(ug/l)----	<10
Iodomethane-----	(ug/l)----	<10
Ethylene Chloride-----	(ug/l)----	3.5
Methyl-2-pentanone-----	(ug/l)----	<10
1,1-Dichloroethene-----	(ug/l)----	<0.50*
trans-1,2-Dichloroethene-----	(ug/l)----	<1.0

LABORATORY REPORT

PAGE : 2

To : Hydrometrics
Address : Attn: Steve Downs
2727 Airport Road
Helena, MT 59601

Lab No. : 91-12772
Date : 6/21/91

WATER ANALYSIS REPORT

Sample Pt Name : HL9104-118
Sample Date : 4/ 5/91
Sample Time : 16:00:00
Sample Received : 4/ 9/91

Helena Landfill

PHASE 1-Volatile Organic Constituents
EPA Method 624, Revised 06/21/91

LABORATORY DATA:

Styrene-----	(ug/l)----	<1.0
1,1,2,2-Tetrachloroethane-----	(ug/l)----	<1.0
Toluene-----	(ug/l)----	<1.0
1,1,1-Trichloroethane-----	(ug/l)----	6.6
1,1,2-Trichloroethane-----	(ug/l)----	<1.0
1,1,2-Trichloroethane-----	(ug/l)----	2.2
1,1,2-Trichloroethane-----	(ug/l)----	2.6
1,2,3-Trichloropropane-----	(ug/l)----	<1.0
Vinyl acetate-----	(ug/l)----	<10
Vinyl chloride-----	(ug/l)----	<0.50
Xylenes-----	(ug/l)----	<1.0
Tetrachloroethene-----	(ug/l)----	13

cc:

LABORATORY REPORT

PAGE : 1

To : Hydrometrics
Address : Attn: Steve Downs
2727 Airport Road
Helena, MT 59061

Lab No. : 91-12772
Date : 4/24/91

WATER ANALYSIS REPORT

Sample Pt Name : HL9104-118
Sample Date : 4/ 5/91
Sample Time : 16:00:00
Sample Received : 4/ 9/91
Helena Landfill

LABORATORY DATA:

Potassium, Dissolved-----	(mg/l)----	4
Sodium, Dissolved-----	(mg/l)----	37
Calcium, Dissolved-----	(mg/l)----	145
Magnesium, Dissolved-----	(mg/l)----	48
Sulfate as SO4-----	(mg/l)----	141
Chloride-----	(mg/l)----	33
Carbonate as CO3-----	(mg/l)----	0
Bicarbonate as HCO3-----	(mg/l)----	487
Solids, Dissolved @ 180 degrees C-----	(mg/l)----	678
Alkalinity, Total as CaCO3, pH 4.5-----	(mg/l)----	399
pH @ 25 degrees C, s.u.-----	(s.u.)----	7.6

cc:

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Randy Huffsmith
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-2767
DATE: 02/09/90 dya

WATER ANALYSIS

Helena Landfill
HL90-2-102
Sampled 02/03/90 @ 1245
Submitted 02/06/90

FEB 1990
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HL90-2

<u>Volatile Organic Constituent</u>	<u>µg/l</u>	<u>Volatile Organic Constituent</u>	<u>µg/l</u>
Dichlorodifluoromethane	5.6	1,1,1,2-Tetrachloroethane	<1.0
Chloromethane	<1.0	Ethylbenzene	<1.0
Vinyl chloride	<0.50	p-Xylene	<1.0
Bromomethane	<1.0	m-Xylene	<1.0
Chloroethane	<1.0	o-Xylene	<1.0
Trichlorofluoromethane	<1.0	Styrene	<1.0
1,1-Dichloroethene	<0.50	Bromoform	<1.0
Methylene Chloride	<1.0*	Isopropylbenzene	<1.0
trans-1,2-Dichloroethene	<1.0	1,1,2,2-Tetrachloroethane	<1.0
1,1-Dichloroethane	2.9	Bromobenzene	<1.0
2,2-Dichloropropane	<1.0	1,2,3-Trichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0	n-Propylbenzene	<1.0
Chloroform	<1.0*	2-Chlorotoluene	<1.0
Bromochloromethane	<1.0	1,3,5-Trimethylbenzene	<1.0
1,1,1-Trichloroethane	2.0	4-Chlorotoluene	<1.0
Carbon Tetrachloride	<0.50	tert-Butylbenzene	<1.0
1,1-Dichloropropene	<1.0	1,2,4-Trimethylbenzene	<1.0
Benzene	<0.50	sec-Butylbenzene	<1.0
1,2-Dichloroethane	<0.50	p-Isopropyltoluene	<1.0
Trichloroethene	<0.50	1,3-Dichlorobenzene	<1.0
1,2-Dichloropropane	<1.0	1,4-Dichlorobenzene	<0.50
Bromodichloromethane	<1.0	n-Butylbenzene	<1.0
Dibromomethane	<1.0	1,2-Dichlorobenzene	<1.0
Toluene	<1.0	1,2-Dibromo-3-Chloropropane	<1.0
1,1,2-Trichloroethane	<1.0	1,2,4-Trichlorobenzene	<1.0
Tetrachloroethene	<0.50*	Hexachlorobutadiene	<1.0
1,3-Dichloropropane	<1.0	Naphthalene	<1.0
Dibromochloromethane	<1.0	1,2,3-Trichlorobenzene	<1.0
1,2-Dibromoethane	<1.0	cis-1,3-Dichloropropene	<1.0
Chlorobenzene	<1.0	trans-1,3-Dichloropropene	<1.0
		Dichloromonofluoromethane	3.4

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA method 502.2.

*Present but less than the practical quantitation limit.

LABORATORY REPORT

PAGE : 1

To : Hydrometrics
Address : Attn: Randy Huffsmith
2727 Airport Road
Helena, MT 59601

Lab No. : 90-2767
Date : 2/12/90

WATER ANALYSIS REPORT

Sample Pt Name : HL90-2-102
Sample Date : 2/ 3/90
Sample Time : 12:45:00
Sample Received : 2/ 6/90
Helena Landfill

HL90-2

LABORATORY DATA:

Potassium, Dissolved-----	(mg/l)----	3
Sodium, Dissolved-----	(mg/l)----	23
Calcium, Dissolved-----	(mg/l)----	121
Magnesium, Dissolved-----	(mg/l)----	35
Sulfate as SO4-----	(mg/l)----	62
Chloride-----	(mg/l)----	32
Carbonate as CO3-----	(mg/l)----	0
Bicarbonate as HCO3-----	(mg/l)----	448
Alkalinity, Dissolved @ 180 degrees C-----	(mg/l)----	511
Total Hardness as CaCO3-----	(mg/l)----	444
Alkalinity, Total as CaCO3, pH 4.5-----	(mg/l)----	367
Conductivity, @ 25 degrees C-----	(umhos/cm)	877
pH @ 25 degrees C, s.u.-----	(s.u.)----	7.9
Nitrate + Nitrite as N-----	(mg/l)----	0.90
Cadmium, Dissolved-----	(mg/l)----	0.005
Copper, Dissolved-----	(mg/l)----	<0.01
Iron, Dissolved-----	(mg/l)----	0.06
Lead, Dissolved-----	(mg/l)----	<0.01
Zinc, Dissolved-----	(mg/l)----	0.02

cc:

FEB 1990
RECEIVED

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Randy Huffsmith
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-12197
DATE: 05/30/90 dya

WATER ANALYSIS

Helena Landfill
HL-9005-120
Sampled 05/10/90 @ 1640
Submitted 05/15/90

MAY 1990
RECEIVED

EPA METHOD 625:

HL90-2

Acid Extractables

	<u>µg/l</u>		<u>µg/l</u>
4-Chloro-3-methylphenol	<10	2-Nitrophenol	<10
2-Chlorophenol	<10	4-Nitrophenol	<50
2,4-Dichlorophenol	<10	Pentachlorophenol	<50
2,4-Dimethylphenol	<10	Phenol	<10
2,4-Dinitrophenol	<50	2,4,6-Trichlorophenol	<10
2-Methyl-4,6-dinitrophenol	<50		

Base Neutral Extractables

	<u>µg/l</u>		<u>µg/l</u>
Acenaphthene	<10	3,3-Dichlorobenzidine	<10
Acenaphthylene	<10	Diethyl phthalate	<10
Anthracene	<10	Dimethyl phthalate	<10
Azobenzene	<10	Di-n-butyl phthalate	<10
Benzidine	<10	2,4-Dinitrotoluene	<10
Benzo(a)anthracene	<10	2,6-Dinitrotoluene	<10
Benzo(a)pyrene	<10	Di-n-octyl phthalate	<10
Benzo(b)fluoranthene	<10	Fluoranthene	<10
Benzo(k)fluoranthene	<10	Fluorene	<10
Benzo(ghi)perylene	<10	Hexachlorobenzene	<10
Bis(2-chloroethoxy)methane	<10	Hexachlorobutadiene	<10
Bis(2-chloroethyl)ether	<10	Hexachloroethane	<10
Bis(2-chloroisopropyl)ether	<10	Indeno (1,2,3-cd)pyrene	<10
Bis(2-ethylhexyl)phthalate	<10	Isophorone	<10
4-Bromophenylphenyl ether	<10	Naphthalene	<10
Butyl benzyl phthalate	<10	Nitrobenzene	<10
2-Chloronaphthalene	<10	N-Nitrosophenylamine	<10
4-Chlorophenylphenyl ether	<10	N-Nitrosodi-n-propylamine	<10
Chrysene	<10	Phenanthrene	<10
Dibenzo(a,h)anthracene	<10	Pyrene	<10
1,2-Dichlorobenzene	<10	1,2,4-Trichlorobenzene	<10
1,3-Dichlorobenzene	<10		
1,4-Dichlorobenzene	<10		

TO: Hydrometrics
ADDRESS: Randy Huffsmith
2727 Airport Road
Helena, MT 59601

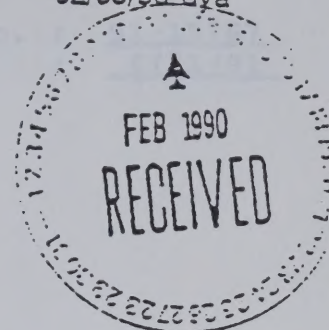
LAB NO.: 90-2765
DATE: 02/09/90 dya

WATER ANALYSIS

Helena Landfill
HL90-2-100

Sampled 02/02/90 @ 1430
Submitted 02/06/90

4490-3



<u>Volatile Organic Constituent</u>	<u>µg/l</u>	<u>Volatile Organic Constituent</u>	<u>µg/l</u>
Dichlorodifluoromethane	1.3	1,1,1,2-Tetrachloroethane	<1.0
Chloromethane	<1.0	Ethylbenzene	<1.0
Vinyl chloride	<0.50	p-Xylene	<1.0
Bromomethane	<1.0	m-Xylene	<1.0
Chloroethane	<1.0	o-Xylene	<1.0
Trichlorofluoromethane	<1.0	Styrene	<1.0
1,1-Dichloroethene	<0.50	Bromoform	<1.0
Methylene Chloride	<1.0*	Isopropylbenzene	<1.0
trans-1,2-Dichloroethene	<1.0	1,1,2,2-Tetrachloroethane	<1.0
1,1-Dichloroethane	1.1	Bromobenzene	<1.0
2,2-Dichloropropane	<1.0	1,2,3-Trichloropropane	<1.0
cis-1,2-Dichloroethene	1.8	n-Propylbenzene	<1.0
Chloroform	5.5	2-Chlorotoluene	<1.0
Bromochloromethane	<1.0	1,3,5-Trimethylbenzene	<1.0
1,1,1-Trichloroethane	<0.50	4-Chlorotoluene	<1.0
Carbon Tetrachloride	<0.50	tert-Butylbenzene	<1.0
1,1-Dichloropropene	<1.0	1,2,4-Trimethylbenzene	<1.0
Benzene	<0.50	sec-Butylbenzene	<1.0
1,2-Dichloroethane	<0.50	p-Isopropyltoluene	<1.0
Trichloroethene	0.60	1,3-Dichlorobenzene	<1.0
1,2-Dichloropropane	<1.0	1,4-Dichlorobenzene	<0.50
Bromodichloromethane	<1.0	n-Butylbenzene	<1.0
Dibromomethane	<1.0	1,2-Dichlorobenzene	<1.0
Toluene	<1.0	1,2-Dibromo-3-Chloropropane	<1.0
1,1,2-Trichloroethane	<1.0	1,2,4-Trichlorobenzene	<1.0
Tetrachloroethene	2.6	Hexachlorobutadiene	<1.0
1,3-Dichloropropane	<1.0	Naphthalene	<1.0
Dibromochloromethane	<1.0	1,2,3-Trichlorobenzene	<1.0
1,2-Dibromoethane	<1.0	cis-1,3-Dichloropropene	<1.0
Chlorobenzene	<1.0	trans-1,3-Dichloropropene	<1.0
		Dichloromonofluoromethane	<1.0*

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA method 502.2.

*Present but less than the practical quantitation limit.

*Present but less than the practical quantitation limit.

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed according with EPA method 800.2.

Concentration (ppm)	Concentration (ppm)
1,2-Dichloroethane	1.0
trans-1,2-Dichloroethane	1.0
cis-1,2-Dichloroethane	1.0
1,2,3-Trichloroethane	1.0
1,2,4-Trichloroethane	1.0
1,3,4-Trichloroethane	1.0
1,2,4,5-Tetrachloroethane	1.0
1,2,3,4-Tetrachloroethane	1.0
1,2,3,5-Tetrachloroethane	1.0
1,2,3,6-Tetrachloroethane	1.0
1,2,4,6-Tetrachloroethane	1.0
1,2,3,7-Tetrachloroethane	1.0
1,2,4,7-Tetrachloroethane	1.0
1,2,3,8-Tetrachloroethane	1.0
1,2,4,8-Tetrachloroethane	1.0
1,2,3,9-Tetrachloroethane	1.0
1,2,4,9-Tetrachloroethane	1.0
1,2,3,10-Tetrachloroethane	1.0
1,2,4,10-Tetrachloroethane	1.0
1,2,3,11-Tetrachloroethane	1.0
1,2,4,11-Tetrachloroethane	1.0
1,2,3,12-Tetrachloroethane	1.0
1,2,4,12-Tetrachloroethane	1.0
1,2,3,13-Tetrachloroethane	1.0
1,2,4,13-Tetrachloroethane	1.0
1,2,3,14-Tetrachloroethane	1.0
1,2,4,14-Tetrachloroethane	1.0
1,2,3,15-Tetrachloroethane	1.0
1,2,4,15-Tetrachloroethane	1.0
1,2,3,16-Tetrachloroethane	1.0
1,2,4,16-Tetrachloroethane	1.0
1,2,3,17-Tetrachloroethane	1.0
1,2,4,17-Tetrachloroethane	1.0
1,2,3,18-Tetrachloroethane	1.0
1,2,4,18-Tetrachloroethane	1.0
1,2,3,19-Tetrachloroethane	1.0
1,2,4,19-Tetrachloroethane	1.0
1,2,3,20-Tetrachloroethane	1.0
1,2,4,20-Tetrachloroethane	1.0
1,2,3,21-Tetrachloroethane	1.0
1,2,4,21-Tetrachloroethane	1.0
1,2,3,22-Tetrachloroethane	1.0
1,2,4,22-Tetrachloroethane	1.0
1,2,3,23-Tetrachloroethane	1.0
1,2,4,23-Tetrachloroethane	1.0
1,2,3,24-Tetrachloroethane	1.0
1,2,4,24-Tetrachloroethane	1.0
1,2,3,25-Tetrachloroethane	1.0
1,2,4,25-Tetrachloroethane	1.0
1,2,3,26-Tetrachloroethane	1.0
1,2,4,26-Tetrachloroethane	1.0
1,2,3,27-Tetrachloroethane	1.0
1,2,4,27-Tetrachloroethane	1.0
1,2,3,28-Tetrachloroethane	1.0
1,2,4,28-Tetrachloroethane	1.0
1,2,3,29-Tetrachloroethane	1.0
1,2,4,29-Tetrachloroethane	1.0
1,2,3,30-Tetrachloroethane	1.0
1,2,4,30-Tetrachloroethane	1.0
1,2,3,31-Tetrachloroethane	1.0
1,2,4,31-Tetrachloroethane	1.0
1,2,3,32-Tetrachloroethane	1.0
1,2,4,32-Tetrachloroethane	1.0
1,2,3,33-Tetrachloroethane	1.0
1,2,4,33-Tetrachloroethane	1.0
1,2,3,34-Tetrachloroethane	1.0
1,2,4,34-Tetrachloroethane	1.0
1,2,3,35-Tetrachloroethane	1.0
1,2,4,35-Tetrachloroethane	1.0
1,2,3,36-Tetrachloroethane	1.0
1,2,4,36-Tetrachloroethane	1.0
1,2,3,37-Tetrachloroethane	1.0
1,2,4,37-Tetrachloroethane	1.0
1,2,3,38-Tetrachloroethane	1.0
1,2,4,38-Tetrachloroethane	1.0
1,2,3,39-Tetrachloroethane	1.0
1,2,4,39-Tetrachloroethane	1.0
1,2,3,40-Tetrachloroethane	1.0
1,2,4,40-Tetrachloroethane	1.0
1,2,3,41-Tetrachloroethane	1.0
1,2,4,41-Tetrachloroethane	1.0
1,2,3,42-Tetrachloroethane	1.0
1,2,4,42-Tetrachloroethane	1.0
1,2,3,43-Tetrachloroethane	1.0
1,2,4,43-Tetrachloroethane	1.0
1,2,3,44-Tetrachloroethane	1.0
1,2,4,44-Tetrachloroethane	1.0
1,2,3,45-Tetrachloroethane	1.0
1,2,4,45-Tetrachloroethane	1.0
1,2,3,46-Tetrachloroethane	1.0
1,2,4,46-Tetrachloroethane	1.0
1,2,3,47-Tetrachloroethane	1.0
1,2,4,47-Tetrachloroethane	1.0
1,2,3,48-Tetrachloroethane	1.0
1,2,4,48-Tetrachloroethane	1.0
1,2,3,49-Tetrachloroethane	1.0
1,2,4,49-Tetrachloroethane	1.0
1,2,3,50-Tetrachloroethane	1.0
1,2,4,50-Tetrachloroethane	1.0
1,2,3,51-Tetrachloroethane	1.0
1,2,4,51-Tetrachloroethane	1.0
1,2,3,52-Tetrachloroethane	1.0
1,2,4,52-Tetrachloroethane	1.0
1,2,3,53-Tetrachloroethane	1.0
1,2,4,53-Tetrachloroethane	1.0
1,2,3,54-Tetrachloroethane	1.0
1,2,4,54-Tetrachloroethane	1.0
1,2,3,55-Tetrachloroethane	1.0
1,2,4,55-Tetrachloroethane	1.0
1,2,3,56-Tetrachloroethane	1.0
1,2,4,56-Tetrachloroethane	1.0
1,2,3,57-Tetrachloroethane	1.0
1,2,4,57-Tetrachloroethane	1.0
1,2,3,58-Tetrachloroethane	1.0
1,2,4,58-Tetrachloroethane	1.0
1,2,3,59-Tetrachloroethane	1.0
1,2,4,59-Tetrachloroethane	1.0
1,2,3,60-Tetrachloroethane	1.0
1,2,4,60-Tetrachloroethane	1.0
1,2,3,61-Tetrachloroethane	1.0
1,2,4,61-Tetrachloroethane	1.0
1,2,3,62-Tetrachloroethane	1.0
1,2,4,62-Tetrachloroethane	1.0
1,2,3,63-Tetrachloroethane	1.0
1,2,4,63-Tetrachloroethane	1.0
1,2,3,64-Tetrachloroethane	1.0
1,2,4,64-Tetrachloroethane	1.0
1,2,3,65-Tetrachloroethane	1.0
1,2,4,65-Tetrachloroethane	1.0
1,2,3,66-Tetrachloroethane	1.0
1,2,4,66-Tetrachloroethane	1.0
1,2,3,67-Tetrachloroethane	1.0
1,2,4,67-Tetrachloroethane	1.0
1,2,3,68-Tetrachloroethane	1.0
1,2,4,68-Tetrachloroethane	1.0
1,2,3,69-Tetrachloroethane	1.0
1,2,4,69-Tetrachloroethane	1.0
1,2,3,70-Tetrachloroethane	1.0
1,2,4,70-Tetrachloroethane	1.0
1,2,3,71-Tetrachloroethane	1.0
1,2,4,71-Tetrachloroethane	1.0
1,2,3,72-Tetrachloroethane	1.0
1,2,4,72-Tetrachloroethane	1.0
1,2,3,73-Tetrachloroethane	1.0
1,2,4,73-Tetrachloroethane	1.0
1,2,3,74-Tetrachloroethane	1.0
1,2,4,74-Tetrachloroethane	1.0
1,2,3,75-Tetrachloroethane	1.0
1,2,4,75-Tetrachloroethane	1.0
1,2,3,76-Tetrachloroethane	1.0
1,2,4,76-Tetrachloroethane	1.0
1,2,3,77-Tetrachloroethane	1.0
1,2,4,77-Tetrachloroethane	1.0
1,2,3,78-Tetrachloroethane	1.0
1,2,4,78-Tetrachloroethane	1.0
1,2,3,79-Tetrachloroethane	1.0
1,2,4,79-Tetrachloroethane	1.0
1,2,3,80-Tetrachloroethane	1.0
1,2,4,80-Tetrachloroethane	1.0
1,2,3,81-Tetrachloroethane	1.0
1,2,4,81-Tetrachloroethane	1.0
1,2,3,82-Tetrachloroethane	1.0
1,2,4,82-Tetrachloroethane	1.0
1,2,3,83-Tetrachloroethane	1.0
1,2,4,83-Tetrachloroethane	1.0
1,2,3,84-Tetrachloroethane	1.0
1,2,4,84-Tetrachloroethane	1.0
1,2,3,85-Tetrachloroethane	1.0
1,2,4,85-Tetrachloroethane	1.0
1,2,3,86-Tetrachloroethane	1.0
1,2,4,86-Tetrachloroethane	1.0
1,2,3,87-Tetrachloroethane	1.0
1,2,4,87-Tetrachloroethane	1.0
1,2,3,88-Tetrachloroethane	1.0
1,2,4,88-Tetrachloroethane	1.0
1,2,3,89-Tetrachloroethane	1.0
1,2,4,89-Tetrachloroethane	1.0
1,2,3,90-Tetrachloroethane	1.0
1,2,4,90-Tetrachloroethane	1.0
1,2,3,91-Tetrachloroethane	1.0
1,2,4,91-Tetrachloroethane	1.0
1,2,3,92-Tetrachloroethane	1.0
1,2,4,92-Tetrachloroethane	1.0
1,2,3,93-Tetrachloroethane	1.0
1,2,4,93-Tetrachloroethane	1.0
1,2,3,94-Tetrachloroethane	1.0
1,2,4,94-Tetrachloroethane	1.0
1,2,3,95-Tetrachloroethane	1.0
1,2,4,95-Tetrachloroethane	1.0
1,2,3,96-Tetrachloroethane	1.0
1,2,4,96-Tetrachloroethane	1.0
1,2,3,97-Tetrachloroethane	1.0
1,2,4,97-Tetrachloroethane	1.0
1,2,3,98-Tetrachloroethane	1.0
1,2,4,98-Tetrachloroethane	1.0
1,2,3,99-Tetrachloroethane	1.0
1,2,4,99-Tetrachloroethane	1.0
1,2,3,100-Tetrachloroethane	1.0
1,2,4,100-Tetrachloroethane	1.0

RECEIVED
FEB 20 1980
LAB. NO. 20-212
DATE: 02/20/80

WATER ANALYSIS
Sampled on 02/19/80 at 1400
Submitted 02/20/80
4-10-80

TO: RANCY HILLMAN
ADDRESS: 2727 South Road
Harrisburg, PA 17101

LABORATORY REPORT

PAGE : 1

To : Hydrometrics
Address : Attn: Steve Downs
2727 Airport Road
Helena, MT 59601

Lab No. : 91-12767
Date : 6/21/91

WATER ANALYSIS REPORT

Sample Pt Name : HL9104-104
Sample Date : 4/ 4/91
Sample Time : 16:00:00
Sample Received : 4/ 9/91

Helena Landfill

PHASE 1-Volatile Organic Constituents
EPA Method 624, Revised 06/21/91

LABORATORY DATA:

Acetone-----	(ug/l)----	<10
Acrolein-----	(ug/l)----	<10
Acrylonitrile-----	(ug/l)----	<10
Benzene-----	(ug/l)----	<0.50
Bromochloromethane-----	(ug/l)----	<1.0
Bromodichloromethane-----	(ug/l)----	<1.0
trans-1,3-Dichloropropene-----	(ug/l)----	<1.0
cis-1,3-Dichloropropene-----	(ug/l)----	<1.0
1,4-Difluorobenzene-----	(ug/l)----	<10
Ethanol-----	(mg/l)----	<10
Ethylbenzene-----	(ug/l)----	<1.0
Ethyl methacrylate-----	(ug/l)----	<10
4-Bromofluorobenzene-----	(ug/l)----	<10
Bromoform-----	(ug/l)----	<1.0
Bromomethane-----	(ug/l)----	<1.0
2-Butanone(Methyl Ethyl Ketone)-----	(ug/l)----	<10
Carbon disulfide-----	(ug/l)----	<10
Carbon Tetrachloride-----	(ug/l)----	<0.50
Chlorobenzene-----	(ug/l)----	<1.0
Dibromochloromethane-----	(ug/l)----	<1.0
Chloroethane-----	(ug/l)----	<1.0
2-Chloroethylvinyl ether-----	(ug/l)----	<10
Chloroform-----	(ug/l)----	<1.0
Chloromethane-----	(ug/l)----	<1.0
Dibromomethane-----	(ug/l)----	<1.0
1,4-Dichloro-2-butene-----	(ug/l)----	<10
Dichlorodifluoromethane-----	(ug/l)----	<1.0*
1,1-Dichloroethane-----	(ug/l)----	2.2
1,2-Dichloroethane-----	(ug/l)----	<0.50
2-Hexanone-----	(ug/l)----	<10
Iodomethane-----	(ug/l)----	<10
Methylene Chloride-----	(ug/l)----	<1.0*
Methyl-2-pentanone-----	(ug/l)----	<10
1,1-Dichloroethene-----	(ug/l)----	<0.50
trans-1,2-Dichloroethene-----	(ug/l)----	<1.0

LABORATORY REPORT

PAGE : 2

To : Hydrometrics
Address : Attn: Steve Downs
2727 Airport Road
Helena, MT 59601

Lab No. : 91-12767
Date : 6/21/91

WATER ANALYSIS REPORT

Sample Pt Name : HL9104-104
Sample Date : 4/ 4/91
Sample Time : 16:00:00
Sample Received : 4/ 9/91

Helena Landfill

PHASE 1-Volatile Organic Constituents
EPA Method 624, Revised 06/21/91

LABORATORY DATA:

Styrene-----	(ug/l)----	<1.0
1,1,2,2-Tetrachloroethane-----	(ug/l)----	<1.0
Toluene-----	(ug/l)----	<1.0
1,1,1-Trichloroethane-----	(ug/l)----	1.0
1,1,2-Trichloroethane-----	(ug/l)----	<1.0
Dichloroethene-----	(ug/l)----	<0.50
Dichlorofluoromethane-----	(ug/l)----	<1.0
1,2,3-Trichloropropane-----	(ug/l)----	<1.0
Vinyl acetate-----	(ug/l)----	<10
Vinyl chloride-----	(ug/l)----	<0.50
Xylenes-----	(ug/l)----	<1.0
Tetrachloroethene-----	(ug/l)----	<0.50

cc:

LABORATORY REPORT

PAGE : 1

To : Hydrometrics
Address : Attn: Steve Downs
2727 Airport Road
Helena, MT 59061

Lab No. : 91-12767
Date : 4/24/91

WATER ANALYSIS REPORT

Sample Pt Name : HL9104-104
Sample Date : 4/ 4/91
Sample Time : 16:00:00
Sample Received : 4/ 9/91
Helena Landfill

LABORATORY DATA:

Potassium, Dissolved-----	(mg/l)----	3
Sodium, Dissolved-----	(mg/l)----	25
Calcium, Dissolved-----	(mg/l)----	116
Magnesium, Dissolved-----	(mg/l)----	33
Sulfate as SO4-----	(mg/l)----	61
Chloride-----	(mg/l)----	31
Carbonate as CO3-----	(mg/l)----	0
Carbonate as HCO3-----	(mg/l)----	428
Alkalinity, Total as CaCO3, pH 4.5-----	(mg/l)----	489
pH @ 25 degrees C, s.u.-----	(mg/l)----	351
Nitrate + Nitrite as N-----	(s.u.)----	7.8
Nitrogen, Ammonia-----	(mg/l)----	0.83
Chemical Oxygen Demand-----	(mg/l)----	<0.1
Organic Carbon, Total-----	(mg/l)----	<1
Cyanide, Total-----	(mg/l)----	2
Arsenic, Dissolved-----	(mg/l)----	<0.005
Barium, Dissolved-----	(mg/l)----	<0.005
Cadmium, Dissolved-----	(mg/l)----	<0.1
Chromium, Dissolved-----	(mg/l)----	0.001
Iron, Dissolved-----	(mg/l)----	<0.02
Lead, Dissolved-----	(mg/l)----	0.12
Manganese, Dissolved-----	(mg/l)----	<0.01
Mercury, Dissolved-----	(mg/l)----	<0.02
Selenium, Dissolved-----	(mg/l)----	<0.001
Silver, Dissolved-----	(mg/l)----	<0.005

cc:

PAGE : 1

LABORATORY REPORT

Lab No. : 100-1000
Date : 1/15/67

Client :
Address :
City :
State :
Zip :

Sample Name :
Sample No. :
Sample Date :
Sample Time :
Sample Location :
Sample Description :

ANALYSIS DATA	UNIT	REMARKS
Carbon, Dissolved	mg/l	
Sulfate, Dissolved	mg/l	
Calcium, Dissolved	mg/l	
Magnesium, Dissolved	mg/l	
Chloride as Cl ⁻	mg/l	
Fluoride as F ⁻	mg/l	
Phosphate as PO ₄	mg/l	
Ammonia as NH ₃	mg/l	
Ammonia, Dissolved	mg/l	
Ammonia, Total as NH ₃ , pH 4.5	mg/l	
Nitrate + Nitrite as N	mg/l	
Nitrate as NO ₃	mg/l	
Nitrite as NO ₂	mg/l	
Organic Carbon, Total	mg/l	
Organic Nitrogen, Total	mg/l	
Organic Phosphorus, Total	mg/l	
Organic Sulfur, Total	mg/l	
Iron, Dissolved	mg/l	
Copper, Dissolved	mg/l	
Zinc, Dissolved	mg/l	
Manganese, Dissolved	mg/l	
Selenium, Dissolved	mg/l	
Silver, Dissolved	mg/l	

LABORATORY REPORT

PAGE : 1

To : Hydrometrics
Address : Attn: Randy Huffsmith
2727 Airport Road
Helena, MT 59601

Lab No. : 90-2765
Date : 2/12/90

WATER ANALYSIS REPORT

Sample Pt Name : HL90-2-100
Sample Date : 2/ 2/90
Sample Time : 14:30:00
Sample Received : 2/ 6/90
Helena Landfill

HL90-3

LABORATORY DATA:

Potassium, Dissolved-----	(mg/l)----	3
Sodium, Dissolved-----	(mg/l)----	80
Calcium, Dissolved-----	(mg/l)----	109
Magnesium, Dissolved-----	(mg/l)----	40
Sulfate as SO4-----	(mg/l)----	136
Chloride-----	(mg/l)----	30
Carbonate as CO3-----	(mg/l)----	0
Carbonate as HCO3-----	(mg/l)----	488
Acids, Dissolved @ 180 degrees C-----	(mg/l)----	686
Total Hardness as CaCO3-----	(mg/l)----	435
Alkalinity, Total as CaCO3, pH 4.5-----	(mg/l)----	400
Conductivity, @ 25 degrees C-----	(umhos/cm)	1130
pH @ 25 degrees C, s.u.-----	(s.u.)----	7.5
Nitrate + Nitrite as N-----	(mg/l)----	5.70
Cadmium, Dissolved-----	(mg/l)----	0.006
Copper, Dissolved-----	(mg/l)----	<0.01
Iron, Dissolved-----	(mg/l)----	<0.03
Lead, Dissolved-----	(mg/l)----	<0.01
Zinc, Dissolved-----	(mg/l)----	0.02

cc:

FEB 1990
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**ENERGY
LABORATORIES****ENERGY LABORATORIES, INC.**P.O. BOX 30916 • 1107 SOUTH BROADWAY • BILLINGS, MT 59107-0916 • PHONE (406) 252-6325
FAX (406) 252-6069 • 1-800-873-5227**LABORATORY REPORT**

PAGE : 1

To : Hydrometrics
 Address : Attn: Steve Downs
 2727 Airport Road
 Helena, MT 59601

Lab No. : 91-12770
 Date : 6/21/91

WATER ANALYSIS REPORT

Sample Pt Name : HL9104-107
 Sample Date : 4/ 5/91
 Sample Time : 14:30:00
 Sample Received : 4/ 9/91

Helena Landfill

PHASE 1-Volatile Organic Constituents
 EPA Method 624, Revised 06/21/91

LABORATORY DATA:

Acetone-----	(ug/l)----	<10
Acrolein-----	(ug/l)----	<10
Acrylonitrile-----	(ug/l)----	<10
Benzene-----	(ug/l)----	<0.50
Bromochloromethane-----	(ug/l)----	<1.0
Bromodichloromethane-----	(ug/l)----	<1.0
trans-1,3-Dichloropropene-----	(ug/l)----	<1.0
trans-1,3-Dichloropropene-----	(ug/l)----	<1.0
1,4-Difluorobenzene-----	(ug/l)----	<10
Ethanol-----	(mg/l)----	<10
Ethylbenzene-----	(ug/l)----	<1.0
Ethyl methacrylate-----	(ug/l)----	<10
4-Bromofluorobenzene-----	(ug/l)----	<10
Bromoform-----	(ug/l)----	<1.0
Bromomethane-----	(ug/l)----	<1.0
2-Butanone(Methyl Ethyl Ketone)-----	(ug/l)----	<10
Carbon disulfide-----	(ug/l)----	<10
Carbon Tetrachloride-----	(ug/l)----	<0.50
Chlorobenzene-----	(ug/l)----	<1.0
Dibromochloromethane-----	(ug/l)----	<1.0
Chloroethane-----	(ug/l)----	<1.0
2-Chloroethylvinyl ether-----	(ug/l)----	5.8
Chloroform-----	(ug/l)----	<1.0
Chloromethane-----	(ug/l)----	<1.0
Dibromomethane-----	(ug/l)----	<1.0
1,4-Dichloro-2-butene-----	(ug/l)----	<10
Dichlorodifluoromethane-----	(ug/l)----	<1.0
1,1-Dichloroethane-----	(ug/l)----	<1.0*
1,2-Dichloroethane-----	(ug/l)----	<0.50
2-Hexanone-----	(ug/l)----	<10
Iodomethane-----	(ug/l)----	<10
Ethylene Chloride-----	(ug/l)----	<1.0
Methyl-2-pentanone-----	(ug/l)----	<10
1,1-Dichloroethene-----	(ug/l)----	<0.50
trans-1,2-Dichloroethene-----	(ug/l)----	<1.0

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LABORATORY REPORT

PAGE : 2

 To : Hydrometrics
 Address : Attn: Steve Downs
2727 Airport Road
Helena, MT 59601

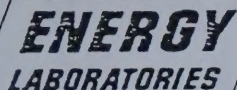
 Lab No. : 91-12770
 Date : 6/21/91
WATER ANALYSIS REPORT
 Sample Pt Name : HL9104-107
 Sample Date : 4/ 5/91
 Sample Time : 14:30:00
 Sample Received : 4/ 9/91

Helena Landfill

 PHASE 1-Volatile Organic Constituents
 EPA Method 624, Revised 06/21/91
LABORATORY DATA:

Styrene-----	(ug/l)----	<1.0
1,1,2,2-Tetrachloroethane-----	(ug/l)----	<1.0
Toluene-----	(ug/l)----	<1.0
1,1,1-Trichloroethane-----	(ug/l)----	<0.50
1,1,2-Trichloroethane-----	(ug/l)----	<1.0
1,1,2-Trichloroethane-----	(ug/l)----	0.65
1,1,2-Trichloroethane-----	(ug/l)----	<1.0
1,1,2-Trichloroethane-----	(ug/l)----	<1.0
1,2,3-Trichloropropane-----	(ug/l)----	<1.0
Vinyl acetate-----	(ug/l)----	<10
Vinyl chloride-----	(ug/l)----	<0.50
Xylenes-----	(ug/l)----	<1.0
Tetrachloroethene-----	(ug/l)----	1.9

cc:



ENERGY LABORATORIES, INC.

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FAX (406) 252-6069 • 1-800-873-5227

LABORATORY REPORT

PAGE : 1

To : Hydrometrics
Address : Attn: Steve Downs
2727 Airport Road
Helena, MT 59061

Lab No. : 91-12770
Date : 4/24/91

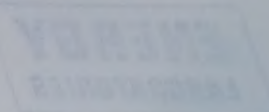
WATER ANALYSIS REPORT

Sample Pt Name : HL9104-107
Sample Date : 4/ 5/91
Sample Time : 14:30:00
Sample Received : 4/ 9/91
Helena Landfill

LABORATORY DATA:

Potassium, Dissolved-----	(mg/l)----	4
Sodium, Dissolved-----	(mg/l)----	83
Calcium, Dissolved-----	(mg/l)----	108
Magnesium, Dissolved-----	(mg/l)----	39
Sulfate as SO4-----	(mg/l)----	134
Chloride-----	(mg/l)----	29
Carbonate as CO3-----	(mg/l)----	0
Carbonate as HCO3-----	(mg/l)----	479
Solids, Dissolved @ 180 degrees C-----	(mg/l)----	662
Alkalinity, Total as CaCO3, pH 4.5-----	(mg/l)----	393
pH @ 25 degrees C, s.u.-----	(s.u.)----	7.7
Nitrate + Nitrite as N-----	(mg/l)----	6.91
Nitrogen, Ammonia-----	(mg/l)----	<0.1
Chemical Oxygen Demand-----	(mg/l)----	3
Organic Carbon, Total-----	(mg/l)----	2
Cyanide, Total-----	(mg/l)----	<0.005
Arsenic, Dissolved-----	(mg/l)----	<0.005
Barium, Dissolved-----	(mg/l)----	<0.1
Cadmium, Dissolved-----	(mg/l)----	0.002
Chromium, Dissolved-----	(mg/l)----	<0.02
Iron, Dissolved-----	(mg/l)----	<0.03
Lead, Dissolved-----	(mg/l)----	<0.01
Manganese, Dissolved-----	(mg/l)----	<0.02
Mercury, Dissolved-----	(mg/l)----	<0.001
Selenium, Dissolved-----	(mg/l)----	<0.005
Silver, Dissolved-----	(mg/l)----	<0.005

CC:



LABORATORY REPORT

PAGE: 1

Lab No.: 91-1234-
Date: 12/12/91

Hydrogenation :
At 101.5 MPa
11.5 MPa
11.5 MPa

WATER ANALYSIS REPORT
Sample ID: 91-1234-101
Sample Date: 12/12/91
Sample Time: 11:30:00
Sample Received: 12/12/91
Helena Landfill

LABORATORY DATA	
Formaldehyde, Dissolved	(mg/l)
Boron, Dissolved	(mg/l)
Calcium, Dissolved	(mg/l)
Magnesium, Dissolved	(mg/l)
Sulfate as SO ₄	(mg/l)
Chloride	(mg/l)
Carbonate as CO ₃	(mg/l)
Phosphate as HCO ₃	(mg/l)
Ammonia, Dissolved & 150 degrees C	(mg/l)
Alkalinity, Total as CaCO ₃ at 17.5	(mg/l)
pH at 25 degrees C, N.T.	
Nitrate + Nitrite as N	(mg/l)
Nitrogen, Ammonia	(mg/l)
Chemical Oxygen Demand	(mg/l)
Organic Carbon, Total	(mg/l)
Cyanide, Total	(mg/l)
Arsenic, Dissolved	(mg/l)
Barium, Dissolved	(mg/l)
Cadmium, Dissolved	(mg/l)
Chromium, Dissolved	(mg/l)
Copper, Dissolved	(mg/l)
Lead, Dissolved	(mg/l)
Manganese, Dissolved	(mg/l)
Mercury, Dissolved	(mg/l)
Selenium, Dissolved	(mg/l)
Silver, Dissolved	(mg/l)

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Randy Huffsmith
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-15043
DATE: 06/18/90 dya

WATER ANALYSIS

Helena City Landfill
HL-9006-105

Sampled 06/06/90 @ 1230

Submitted 06/07/90

625 WILDER (CITY WATER)

Volatile Organic Constituent

	<u>µg/l</u>
Dichlorodifluoromethane	<1.0
Chloromethane	<1.0
Vinyl chloride	<0.50
Bromomethane	<1.0
Chloroethane	<1.0
Trichlorofluoromethane	<1.0
1,1-Dichloroethene	<0.50
Methylene Chloride	<1.0
trans-1,2-Dichloroethene	<1.0
1,1-Dichloroethane	<1.0
2,2-Dichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0
Chloroform	70
Bromochloromethane	<1.0
1,1,1-Trichloroethane	<0.50
Carbon Tetrachloride	<0.50
1,1-Dichloropropene	<1.0
Benzene	<0.50
1,2-Dichloroethane	<0.50
Trichloroethene	<0.50
1,2-Dichloropropane	<1.0
Bromodichloromethane	3.2
Dibromomethane	<1.0
Toluene	<1.0
1,1,2-Trichloroethane	<1.0
Tetrachloroethene	<0.50
1,3-Dichloropropane	<1.0
Dibromochloromethane	<1.0
1,2-Dibromoethane	<1.0
Chlorobenzene	<1.0

Volatile Organic Constituent

	<u>µg/l</u>
1,1,1,2-Tetrachloroethane	<1.0
Ethylbenzene	<1.0
p-Xylene	<1.0
m-Xylene	<1.0
o-Xylene	<1.0
Styrene	<1.0
Bromoform	<1.0
Isopropylbenzene	<1.0
1,1,2,2-Tetrachloroethane	<1.0
Bromobenzene	<1.0
1,2,3-Trichloropropane	<1.0
n-Propylbenzene	<1.0
2-Chlorotoluene	<1.0
1,3,5-Trimethylbenzene	<1.0
4-Chlorotoluene	<1.0
tert-Butylbenzene	<1.0
1,2,4-Trimethylbenzene	<1.0
sec-Butylbenzene	<1.0
p-Isopropyltoluene	<1.0
1,3-Dichlorobenzene	<1.0
1,4-Dichlorobenzene	<0.50
n-Butylbenzene	<1.0
1,2-Dichlorobenzene	<1.0
1,2-Dibromo-3-Chloropropane	<1.0
1,2,4-Trichlorobenzene	<1.0
Hexachlorobutadiene	<1.0
Naphthalene	<1.0
1,2,3-Trichlorobenzene	<1.0
cis-1,3-Dichloropropene	<1.0
trans-1,3-Dichloropropene	<1.0
Dichloromonofluoromethane	<1.0

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed accordance with EPA Method 502.2.

*Present but less than the practical quantitation limit.

COMPLETE ENVIRONMENTAL ANALYTICAL SERVICE

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Randy Huffsmith
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-15041
DATE: 06/18/90 dya

WATER ANALYSIS

Helena City Landfill

HL-9006-103

Sampled 06/05/90 @ 1120

Submitted 06/07/90

CARWASH (CITY WATER)

<u>Volatile Organic Constituent</u>	<u>µg/l</u>	<u>Volatile Organic Constituent</u>	<u>µg/l</u>
Dichlorodifluoromethane	<1.0	1,1,1,2-Tetrachloroethane	<1.0
Chloromethane	<1.0	Ethylbenzene	<1.0
Vinyl chloride	<0.50	p-Xylene	<1.0
Bromomethane	<1.0	m-Xylene	<1.0
Chloroethane	<1.0	o-Xylene	<1.0
Trichlorofluoromethane	<1.0	Styrene	<1.0
1,1-Dichloroethene	<0.50	Bromoform	<1.0
Methylene Chloride	<1.0	Isopropylbenzene	<1.0
trans-1,2-Dichloroethene	<1.0	1,1,2,2-Tetrachloroethane	<1.0
1,1-Dichloroethane	<1.0	Bromobenzene	<1.0
2,2-Dichloropropane	<1.0	1,2,3-Trichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0	n-Propylbenzene	<1.0
Chloroform	88	2-Chlorotoluene	<1.0
Bromochloromethane	<1.0	1,3,5-Trimethylbenzene	<1.0
1,1,1-Trichloroethane	<0.50	4-Chlorotoluene	<1.0
Carbon Tetrachloride	<0.50	tert-Butylbenzene	<1.0
1,1-Dichloropropene	<1.0	1,2,4-Trimethylbenzene	<1.0
Benzene	<0.50	sec-Butylbenzene	<1.0
1,2-Dichloroethane	<0.50	p-Isopropyltoluene	<1.0
Trichloroethene	<0.50	1,3-Dichlorobenzene	<1.0
1,2-Dichloropropane	<1.0	1,4-Dichlorobenzene	<0.50
Bromodichloromethane	5.5	n-Butylbenzene	<1.0
Dibromomethane	<1.0	1,2-Dichlorobenzene	<1.0
Toluene	<1.0	1,2-Dibromo-3-Chloropropane	<1.0
1,1,2-Trichloroethane	<1.0	1,2,4-Trichlorobenzene	<1.0
Tetrachloroethene	<0.50	Hexachlorobutadiene	<1.0
1,3-Dichloropropane	<1.0	Naphthalene	<1.0
Dibromochloromethane	1.1	1,2,3-Trichlorobenzene	<1.0
1,2-Dibromoethane	<1.0	cis-1,3-Dichloropropene	<1.0
Chlorobenzene	<1.0	trans-1,3-Dichloropropene	<1.0
		Dichloromonofluoromethane	<1.0

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA Method 502.2.

*Present but less than the practical quantitation limit.

COMPLETE ENVIRONMENTAL ANALYTICAL SERVICE

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Randy Huffsmith
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-15039
DATE: 06/18/90 dya

WATER ANALYSIS

Helena City Landfill
HL-9006-101

Sampled 06/05/90 @ 1045

Submitted 06/07/90

FAIRGROUNDS (CITY WATER)

<u>Volatile Organic Constituent</u>	<u>µg/l</u>	<u>Volatile Organic Constituent</u>	<u>µg/l</u>
Dichlorodifluoromethane	<1.0	1,1,1,2-Tetrachloroethane	<1.0
Chloromethane	<1.0	Ethylbenzene	<1.0
Vinyl chloride	<0.50	p-Xylene	<1.0
Bromomethane	<1.0	m-Xylene	<1.0
Chloroethane	<1.0	o-Xylene	<1.0
Trichlorofluoromethane	<1.0	Styrene	<1.0
1,1-Dichloroethene	<0.50	Bromoform	<1.0
Methylene Chloride	<1.0	Isopropylbenzene	<1.0
trans-1,2-Dichloroethene	<1.0	1,1,2,2-Tetrachloroethane	<1.0
1,1-Dichloroethane	<1.0	Bromobenzene	<1.0
2,2-Dichloropropane	<1.0	1,2,3-Trichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0	n-Propylbenzene	<1.0
Chloroform	88	2-Chlorotoluene	<1.0
Bromochloromethane	<1.0	1,3,5-Trimethylbenzene	<1.0
1,1,1-Trichloroethane	<0.50	4-Chlorotoluene	<1.0
Carbon Tetrachloride	<0.50	tert-Butylbenzene	<1.0
1,1-Dichloropropene	<1.0	1,2,4-Trimethylbenzene	<1.0
Benzene	<0.50	sec-Butylbenzene	<1.0
1,2-Dichloroethane	<0.50	p-Isopropyltoluene	<1.0
Trichloroethene	<0.50	1,3-Dichlorobenzene	<1.0
1,2-Dichloropropane	<1.0	1,4-Dichlorobenzene	<0.50
Bromodichloromethane	5.3	n-Butylbenzene	<1.0
Dibromomethane	<1.0	1,2-Dichlorobenzene	<1.0
Toluene	<1.0	1,2-Dibromo-3-Chloropropane	<1.0
1,1,2-Trichloroethane	<1.0	1,2,4-Trichlorobenzene	<1.0
Tetrachloroethene	<0.50	Hexachlorobutadiene	<1.0
1,3-Dichloropropane	<1.0	Naphthalene	<1.0
Dibromochloromethane	<1.0	1,2,3-Trichlorobenzene	<1.0
1,2-Dibromoethane	<1.0	cis-1,3-Dichloropropene	<1.0
Chlorobenzene	<1.0	trans-1,3-Dichloropropene	<1.0
		Dichloromonofluoromethane	<1.0

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA Method 502.2.

*Present but less than the practical quantitation limit.

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Billy Pratt
2727 Airport Road
Helena, MT 59620

LAB NO.: 89-20180 -85

DATE: 11/27/89 dya

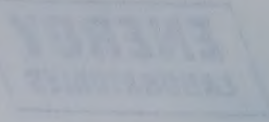
EPA WATER SUPPLY QUALITY CONTROL SAMPLE

Volatile Organic Contaminants

This EPA reference sample was analyzed with your sample no.s 89-20180 -85
with the following results:

<u>Parameter</u>	<u>True Value. $\mu\text{g/l}$</u>	<u>P (%)</u>	<u>Range for P (%)</u>
Benzene	4.9	103	60 - 140
Ethylbenzene	5.0	114	60 - 140
m-Xylene	4.9	120	60 - 140
n-propylbenzene	5.0	104	60 - 140
2-Chlorotoluene	5.0	98	60 - 140
1,3,5-Trimethylbenzene	5.0	110	60 - 140
1,4-Dichlorobenzene	5.2	103	60 - 140

P = Percent recovery measured.



ENERGY LABORATORIES, INC.

LABORATORY REPORT

TO: ADDRESS:

Hydrochem
Box 144
1755 Airport Road
Indian, MT 59602

LAB NO: 88-0782-02
DATE: 1/27/88

EPA WATER QUALITY CONTROL SAMPLE

Volatile Organic Compounds

The EPA reference sample was analyzed with your sample and the following results:

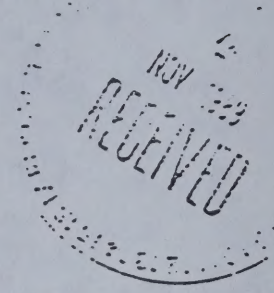
Parameter	The Value (ppb)	P (ppb)	Range for P (ppb)
Benzene	4.5	100	50 - 140
Ethylbenzene	8.0	114	60 - 140
m-Xylene	4.5	100	50 - 140
p-Xylene	5.0	104	50 - 140
o-Chlorobenzene	5.0	99	50 - 140
1,2,4-Trichlorobenzene	5.0	110	50 - 140
1,4-Dichlorobenzene	5.5	102	50 - 140

P = Percent recovery method.

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Billy Pratt
2727 Airport Road
Helena, MT 59601

LAB NO.: 89-20181 spi
DATE: 11/27/89 dya

QUALITY ASSURANCE - SPIKED ANALYSIS

Lab No. 89-20181 was spiked with the following constituents with these results:

<u>Constituent</u>	<u>Spike Amount. ug/l</u>	<u>Ps (%)</u>	<u>Range for Ps (%)</u>
Toluene	5.0	100	60 - 140
Chlorobenzene	5.0	108	60 - 140
Isopropylbenzene	5.0	88	60 - 140
sec-Butylbenzene	5.0	104	60 - 140
1,2,4-Trimethylbenzene	5.0	92	60 - 140
n-Butylbenzene	5.0	100	60 - 140
1,2-Dichlorobenzene	5.0	96	60 - 140

Ps = Percent recovery measured.

LABORATORY REPORT

TO: ADDRESS:

Hydrocarbon
500 East
2727 Airport Road
Spring, MA 01103

LAS NO: 88-00181
DATE: 11/27/88

QUALITY ASSURANCE - SPIKED ANALYSIS

LAS No. 88-00181 was spiked with the following components with these results:

Component	Spiked Amount, wt%	EA (wt%)	Recovery for EA (%)
Toluene	5.0	100	50 - 140
Chlorobenzene	5.0	100	50 - 140
Isopropylbenzene	5.0	98	50 - 140
sec-Butylbenzene	5.0	104	50 - 140
1,2,4-Trichlorobenzene	5.0	98	50 - 140
n-Butylbenzene	5.0	100	50 - 140
1,2-Dichlorobenzene	5.0	98	50 - 140

PS = Percent recovery measured



ENERGY LABORATORIES, INC.

P.O. BOX 30916 • 1107 SOUTH BROADWAY • BILLINGS, MT 59107-0916 • PHONE (406) 252-6325
FAX (406) 252-6069 • 1-800-673-5227

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Randy Huffsmith
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-7837
DATE: 04/27/90 dya

Water Volatile Surrogate Recovery

<u>Sample No.</u>	<u>S1 (TOL)#</u>	<u>S2 (BFB)#</u>	<u>S3 (DCE)#</u>
90-7837	115	104	110

QC Limits

S1 (TOL) = Toluene-d8
S2 (BFB) = Bromofluorobenzene
S3 (DCE) = 1,2-Dichloroethane-d4

80 - 120
80 - 120
80 - 120

Column to be used to flag recovery values with an asterisk.

* Values outside of contract required QC limits.

ENERGY

LABORATORY

ENERGY LABORATORIES, INC.

10000 W. 10th Ave. • Denver, CO 80202 • (303) 751-1000
10000 W. 10th Ave. • Denver, CO 80202 • (303) 751-1000

LABORATORY REPORT

LAB NO: 80-757
DATE: 04/25/80

TO: RANNEY
FROM: RANNEY
10000 W. 10th Ave.
Denver, CO 80202

TO: ADDRESS:

WATER VAPOR ANALYSIS

Sample No	TIME	WATER	WATER
80-757	1:15	104	110

WATER

80 - 100
80 - 100
80 - 100

81 (TOL) = Toluene
82 (BPS) = Bromobenzene
83 (DCB) = 1,2-Dichlorobenzene

* Column to be used to get recovery values with an external

* Values outside of control indicated GC limit

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Steve Downs
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-10831
DATE: 05/23/90 dya

QUALITY ASSURANCE - SPIKED ANALYSIS

Lab No. 90-10831 was spiked with the following constituents with these results:

<u>Constituent</u>	<u>Spike Amount. ug/l</u>	<u>P (%)</u>	<u>Range for P (%)</u>
1,1-Dichloroethene	5.0	113	60 - 140
Benzene	5.0	119	60 - 140
Trichloroethene	5.0	134	60 - 140
Toluene	5.0	108	60 - 140
Chlorobenzene	5.0	124	60 - 140

P = Percent recovery measured.

LABORATORY REPORT

LAS NO.: 80-1023
DATE: 04/23/88

TO:
ADDRESS:
Hysteresis
Drive Drive
2727 Arden Road
Harris, MT 59901

QUALITY ASSURANCE - REPEATED ANALYSIS

LAS No. 80-1023 was spiked with the following constituents with these results:

Constituent	Spiked Amount (ug)	Found (ug)	Range for 5 (ug)
1,1-Dichloroethane	5.0	113	50 - 140
Benzene	5.0	118	50 - 140
Trichloroethene	5.0	124	50 - 140
Toluene	5.0	108	50 - 140
Chlorobenzene	5.0	124	50 - 140

g = Percent recovery measured.

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Steve Downs
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-10821
DATE: 05/23/90 dya

QUALITY ASSURANCE - SPIKED ANALYSIS

Lab No. 90-10821 was spiked with the following constituents with these results:

<u>Constituent</u>	<u>Spike Amount, ug/l</u>	<u>P (%)</u>	<u>Range for P (%)</u>
1,1-Dichloroethene	5.0	102	60 - 140
Benzene	5.0	126	60 - 140
Trichloroethene	5.0	117	60 - 140
Toluene	5.0	122	60 - 140
Chlorobenzene	5.0	126	60 - 140

P = Percent recovery measured.

LABORATORY REPORT

LAB NO.: 20-1234
DATE: 05/20/2024

TO: HYDROGEN
ADDRESS: 1234 Main St.
Rt. 1, Box 123
Windsor, VT 05691

QUALITY ASSURANCE - SELECT ANALYSES

Lab No. 20-1234 was spiked with the following constituents with these results:

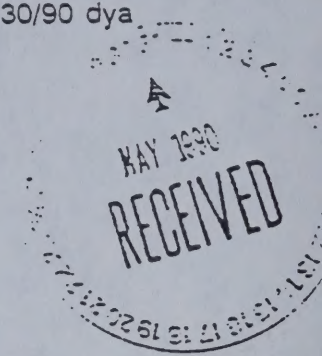
Constituent	Spiked Amount (µg)	Found (µg)	Range (µg)
1,1-Dichloroethane	5.0	4.8	5.0 ± 1.0
Benzene	5.0	4.9	5.0 ± 1.0
Trichloroethane	5.0	4.7	5.0 ± 1.0
Toluene	5.0	4.6	5.0 ± 1.0
Chlorobenzene	5.0	4.5	5.0 ± 1.0

µ = Percent recovery measured

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Randy Huffsmith
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-12197 -99
DATE: 05/30/90 dya

WATER SEMIVOLATILE SURROGATE RECOVERY

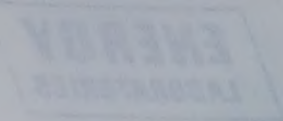
<u>Sample No.</u>	<u>S1 (NBZ)#</u>	<u>S2 (FBP)#</u>	<u>S3 (TPH)#</u>	<u>S4 (PHL)#</u>	<u>S5 (2FP)#</u>	<u>S6 (TBP)#</u>
90-12197	43	56	140	31	30	46
90-12198	67	70	85	22	22	38
90-12199	69	75	94	21	21	38

QC LIMITS

S1 (NBZ) = Nitrobenzene-d5	35-114
S2 (FBP) = 2-Fluorobiphenyl	43-116
S3 (TPH) = Terphenyl-d14	33-141
S4 (PHL) = Phenol-d5	10-94
S5 (2FP) = 2-Fluorophenol	21-100
S6 (TBP) = 2,4,6-Tribromophenol	10-123

Column to be used to flag recovery values with an asterisk.

* Values outside of contract required QC limits



LABORATORY REPORT

TO: _____
 ADDRESS: _____

PROJECT: _____
 ANALYST: _____
 2025 ALPINE ROAD
 HYATTSVILLE, MD 20635

LAB NO.: 82-1217-00
 DATE: 08/20/82



WATER REMEDIATION SUBSISTENCE RECOVERY

DATE	TIME	TEMP	PH	COND	RES
08-12-82	12	14.0	7.1	20	48
08-12-82	17	8.0	7.2	22	38
08-12-82	22	8.8	7.1	21	35

GC LIMITS

08-17-82	01 (M2) = Methylene-Cl
08-17-82	02 (M3) = 2-Chlorophenol
08-17-82	03 (M4) = Toluene-4
08-17-82	04 (M5) = Phenol-2
08-17-82	05 (M6) = 2-Phenol
08-17-82	06 (M7) = 2,4-Dichlorophenol

* Column is to be used to log recovery values with an alarm.

* Values outside of control require GC limits

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Randy Huffsmith
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-15041
DATE: 06/18/90 dya

QUALITY ASSURANCE - SPIKED ANALYSIS

Lab No. 90-15041 was spiked with the following constituents with these results:

<u>Constituent</u>	<u>Spike Amount, ug/l</u>	<u>P (%)</u>	<u>Range for P (%)</u>
1,1-Dichloroethene	5.0	64	60 - 140
Benzene	5.0	96	60 - 140
Trichloroethene	5.0	93	60 - 140
Toluene	5.0	100	60 - 140
Chlorobenzene	5.0	104	60 - 140

P = Percent recovery measured.

LABORATORY REPORT

LAB NO: 80-15047
DATE: 08/15/93

TO: HYDROCARBON
FROM: RICHARD J. HARRIS
100 BOX 3015
NEW YORK, NY 10038

QUALITY ASSURANCE - SPIKED ANALYSIS

Lab No. 80-15047 was spiked with the following compounds with these results:

Compound	Spiked Amount (ug)	Found (ug)	Recovery (%)
1,1-Dichloroethane	5.0	4.8	96
Benzene	5.0	4.9	98
Trichloroethane	5.0	4.7	94
Toluene	5.0	4.6	92
Chlorobenzene	5.0	4.5	90

P = Percent recovery measured.

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Steve Downs
2727 Airport Road
Helena, MT 59601

LAB NO.: 91-13086 -88
DATE: 04/29/91 da

WATER VOLATILE SURROGATE RECOVERY

10 µg/l Surrogate Standard Spike

<u>SAMPLE NO.</u>	-----% recovery-----		
	<u>S1</u> <u>(TOL)#</u>	<u>S2</u> <u>(BFB)#</u>	<u>S3</u> <u>(DCE)#</u>
91-13086	96	104	92
91-13087	97	102	91
91-13088	88	101	100

S1 (TOL) = Toluene-d8
S2 (BFB) = Bromofluorobenzene
S3 (DCE) = 1,2-Dichloroethane-d4

QC LIMITS, % Recovery

80-120
80-120
80-120

#Column to be used to flag recovery values with an asterisk.

*Values outside of contract required QC limits.

LABORATORY REPORT

LAS NO: 97-13088-88
DATE: 04/23/97

TO: Hydrometals
ADDRESS: Steve Downs
2727 Airport Road
Helena, MT 59601

WATER VOLATILE SUBSTRATE RECOVERY

15 mg Standard Sample

RECOVERY NO.	ST	ST	ST
97-13088	98	98	98
97-13087	97	97	97
97-13086	96	96	96

CC (WATS) IN Recovery

80-130
80-130
80-130

ST (TOL) = Toluenes-48
ST (BFI) = Bromofluorobenzene
ST (DCB) = 1,2-Dichlorobenzene-48

*Column to be used to log recovery values with an asterisk.

*Values outside of contract required CC units.

LABORATORY REPORT

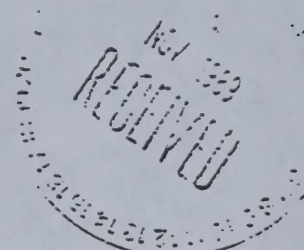
TO: Hydrometrics
ADDRESS: Billy Pratt
2727 Airport Road
Helena, MT 59601

LAB NO.: 89-20184
DATE: 11/27/89 dya

*Di BLANK*WATER ANALYSIS

Helena Landfill
HL-8911-005

Sampled 11/11/89 @ 1900
Submitted 11/14/89



<u>Volatile Organic Constituent</u>	<u>µg/l</u>	<u>Volatile Organic Constituent</u>	<u>µg/l</u>
Dichlorodifluoromethane	<1.0	1,1,1,2-Tetrachloroethane	<1.0
Chloromethane	<1.0	Ethylbenzene	<1.0
Vinyl chloride	<0.50	p-Xylene	<1.0
Bromomethane	<1.0	m-Xylene	<1.0
Chloroethane	<1.0	o-Xylene	<1.0
Trichlorofluoromethane	<1.0	Styrene	<1.0
1,1-Dichloroethene	<0.50	Bromoform	<1.0
Methylene Chloride	<1.0	Isopropylbenzene	<1.0
trans-1,2-Dichloroethene	<1.0	1,1,2,2-Tetrachloroethane	<1.0
1,1-Dichloroethane	<1.0	Bromobenzene	<1.0
2,2-Dichloropropane	<1.0	1,2,3-Trichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0	n-Propylbenzene	<1.0
Chloroform	<1.0	2-Chlorotoluene	<1.0
Bromochloromethane	<1.0	1,3,5-Trimethylbenzene	<1.0
1,1,1-Trichloroethane	<0.50	4-Chlorotoluene	<1.0
Carbon Tetrachloride	<0.50	tert-Butylbenzene	<1.0
1,1-Dichloropropene	<1.0	1,2,4-Trimethylbenzene	<1.0
Benzene	0.73	sec-Butylbenzene	<1.0
1,2-Dichloroethane	<0.50	p-Isopropyltoluene	<1.0
Trichloroethene	<0.50	1,3-Dichlorobenzene	<1.0
1,2-Dichloropropane	<1.0	1,4-Dichlorobenzene	<0.50
Bromodichloromethane	<1.0	n-Butylbenzene	<1.0
Dibromomethane	<1.0	1,2-Dichlorobenzene	<1.0
Toluene	1.0	1,2-Dibromo-3-Chloropropane	<1.0
1,1,2-Trichloroethane	<1.0	1,2,4-Trichlorobenzene	<1.0
Tetrachloroethene	<0.50	Hexachlorobutadiene	<1.0
1,3-Dichloropropane	<1.0	Naphthalene	<1.0
Dibromochloromethane	<1.0	1,2,3-Trichlorobenzene	<1.0
1,2-Dibromoethane	<1.0	cis-1,3-Dichloropropene	<1.0
Chlorobenzene	<1.0	trans-1,3-Dichloropropene	<1.0

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed accordance with EPA method 502.2

*Present but less than the practical quantitation limit.

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Steve Downs
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-10832
DATE: 05/23/90 dya

WATER ANALYSIS

Helena Landfill
HL-9005-115
Sampled 05/07/90 @ 0915
Submitted 05/08/90

BLANK

Volatile Organic Constituent

	<u>µg/l</u>
Dichlorodifluoromethane	<1.0
Chloromethane	<1.0
Vinyl chloride	<0.50
Bromomethane	<1.0
Chloroethane	<1.0
Trichlorofluoromethane	<1.0
1,1-Dichloroethene	<0.50
Methylene Chloride	<1.0
trans-1,2-Dichloroethene	<1.0
1,1-Dichloroethane	<1.0
2,2-Dichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0
Chloroform	<1.0
Bromochloromethane	<1.0
1,1,1-Trichloroethane	<0.50
Carbon Tetrachloride	<0.50
1,1-Dichloropropene	<1.0
Benzene	<0.50
1,2-Dichloroethane	<0.50
Trichloroethene	<0.50
1,2-Dichloropropane	<1.0
Bromodichloromethane	<1.0
Dibromomethane	<1.0
Toluene	<1.0
1,1,2-Trichloroethane	<1.0
Tetrachloroethene	<0.50
1,3-Dichloropropane	<1.0
Dibromochloromethane	<1.0
1,2-Dibromoethane	<1.0
Chlorobenzene	<1.0

Volatile Organic Constituent

	<u>µg/l</u>
1,1,1,2-Tetrachloroethane	<1.0
Ethylbenzene	<1.0
p-Xylene	<1.0
m-Xylene	<1.0
o-Xylene	<1.0
Styrene	<1.0
Bromoform	<1.0
Isopropylbenzene	<1.0
1,1,2,2-Tetrachloroethane	<1.0
Bromobenzene	<1.0
1,2,3-Trichloropropane	<1.0
n-Propylbenzene	<1.0
2-Chlorotoluene	<1.0
1,3,5-Trimethylbenzene	<1.0
4-Chlorotoluene	<1.0
tert-Butylbenzene	<1.0
1,2,4-Trimethylbenzene	<1.0
sec-Butylbenzene	<1.0
p-Isopropyltoluene	<1.0
1,3-Dichlorobenzene	<1.0
1,4-Dichlorobenzene	<0.50
n-Butylbenzene	<1.0
1,2-Dichlorobenzene	<1.0
1,2-Dibromo-3-Chloropropane	<1.0
1,2,4-Trichlorobenzene	<1.0
Hexachlorobutadiene	<1.0
Naphthalene	<1.0
1,2,3-Trichlorobenzene	<1.0
cis-1,3-Dichloropropene	<1.0
trans-1,3-Dichloropropene	<1.0
Dichloromonofluoromethane	<1.0

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed accordance with EPA Method 502.2

*Present but less than the practical quantitation limit.

COMPLETE ENVIRONMENTAL ANALYTICAL SERVICE

APPENDIX D.

SOIL TESTING RESULTS

HELENA LANDFILL
DOUBLE RING INFILTRMETER TESTS

SITE NAME: HLDR-1

DRY RUN

TIME SINCE TEST START (MINUTES)	VOLUME ADDED TO INNER RING (ML)	INFILTRATION RATE (CM/SEC)
5	90	5.93E-04
35	50	5.49E-05
65	40	4.39E-05
95	40	4.39E-05
100	5	3.29E-05

WET RUN

TIME SINCE TEST START (MINUTES)	VOLUME ADDED TO INNER RING (ML)	INFILTRATION RATE (CM/SEC)
20	15	2.47E-05
50	35	3.84E-05
80	35	3.84E-05
110	40	4.39E-05

STATE OF NEW YORK
 COUNTY OF ALBANY

IN SENATE

REPORT OF THE COMMISSIONER OF THE DEPARTMENT OF SOCIAL SERVICES		FOR THE YEAR ENDING DECEMBER 31, 1964	
STATE	FEDERAL	STATE	FEDERAL
100	100	100	100
100	100	100	100
100	100	100	100
100	100	100	100
100	100	100	100

REPORT OF THE COMMISSIONER OF THE DEPARTMENT OF SOCIAL SERVICES		FOR THE YEAR ENDING DECEMBER 31, 1964	
STATE	FEDERAL	STATE	FEDERAL
100	100	100	100
100	100	100	100
100	100	100	100
100	100	100	100
100	100	100	100

HELENA LANDILL
DOUBLE RING INFILTRMETER TESTS

SITE NAME: HLDL-2

DRY RUN

TIME SINCE TEST START (MINUTES)	VOLUME ADDED TO INNER RING (ML)	INFILTRATION RATE (CM/SEC)
5	90	5.93E-04
20	60	1.32E-04
60	110	9.06E-05

WET RUN

TIME SINCE TEST START (MINUTES)	VOLUME ADDED TO INNER RING (ML)	INFILTRATION RATE (CM/SEC)
30	80	8.78E-05
60	80	8.78E-05

HELMAN, J. L.
 DOUBLE AND SINGLE RING TESTS

SITE NAME: HELM

TEST RESULTS

TEST NAME	TEST DATE	TEST RESULT
DOUBLE RING TEST	10/10/10	100%
SINGLE RING TEST	10/10/10	100%

TEST RESULTS

TEST NAME	TEST DATE	TEST RESULT
DOUBLE RING TEST	10/10/10	100%
SINGLE RING TEST	10/10/10	100%

HELENA LANDILL
DOUBLE RING INFILTRMETER TESTS

SITE NAME: HLDL-3

DRY RUN

TIME SINCE TEST START (MINUTES)	VOLUME ADDED TO INNER RING (ML)	INFILTRATION RATE (CM/SEC)
5	450	2.96E-03
13	180	7.41E-04
28	260	5.71E-04
58	380	4.17E-04

WET RUN

TIME SINCE TEST START (MINUTES)	VOLUME ADDED TO INNER RING (ML)	INFILTRATION RATE (CM/SEC)
30	420	4.61E-04
60	390	4.28E-04
90	390	4.28E-04

HELINA JAWOUL
DOUBLE WING DIFFERENTIAL TESTS

SITE NAME: H.D. 1

TEST RUN		TEST START DATE AND TIME		TEST STOP DATE AND TIME	
TEST RUN	TEST RUN	TEST START DATE AND TIME	TEST STOP DATE AND TIME	TEST START DATE AND TIME	TEST STOP DATE AND TIME
1	1	1/1/2010	1/1/2010	1/1/2010	1/1/2010
2	2	1/1/2010	1/1/2010	1/1/2010	1/1/2010
3	3	1/1/2010	1/1/2010	1/1/2010	1/1/2010
4	4	1/1/2010	1/1/2010	1/1/2010	1/1/2010
5	5	1/1/2010	1/1/2010	1/1/2010	1/1/2010

TEST RUN		TEST START DATE AND TIME		TEST STOP DATE AND TIME	
TEST RUN	TEST RUN	TEST START DATE AND TIME	TEST STOP DATE AND TIME	TEST START DATE AND TIME	TEST STOP DATE AND TIME
1	1	1/1/2010	1/1/2010	1/1/2010	1/1/2010
2	2	1/1/2010	1/1/2010	1/1/2010	1/1/2010
3	3	1/1/2010	1/1/2010	1/1/2010	1/1/2010
4	4	1/1/2010	1/1/2010	1/1/2010	1/1/2010
5	5	1/1/2010	1/1/2010	1/1/2010	1/1/2010

HELENA LANDILL
DOUBLE RING INFILTROMETER TESTS

SITE NAME: HLD R-4

DRY RUN

TIME SINCE TEST START (MINUTES)	VOLUME ADDED TO INNER RING (ML)	INFILTRATION RATE (CM/SEC)
5	525	3.46E-03
15	100	3.29E-04
30	130	2.85E-04
60	215	2.36E-04

WET RUN

TIME SINCE TEST START (MINUTES)	VOLUME ADDED TO INNER RING (ML)	INFILTRATION RATE (CM/SEC)
30	180	1.98E-04
60	155	1.70E-04
90	220	2.42E-04

HELMAN JACOB
DOUBLE RING PALLIOMETER TEST

SITE NAME: HELMAN

DRY RUN

TEST START DRY RUN	TEST END DRY RUN	TIME TO FILL (MIN)	WATER VOLUME (GALLONS)
12:00	12:05	5	100
12:05	12:10	5	100
12:10	12:15	5	100
12:15	12:20	5	100

WET RUN

TEST START WET RUN	TEST END WET RUN	TIME TO FILL (MIN)	WATER VOLUME (GALLONS)
12:25	12:30	5	100
12:30	12:35	5	100
12:35	12:40	5	100

HELENA LANDILL
DOUBLE RING INFILTRMETER TESTS

SITE NAME: RPDR-1

DRY RUN

TIME SINCE TEST START (MINUTES)	VOLUME ADDED TO INNER RING (ML)	INFILTRATION RATE (CM/SEC)
15	170	3.73E-04
45	90	9.88E-05
115	70	3.29E-05

WET RUN

TIME SINCE TEST START (MINUTES)	VOLUME ADDED TO INNER RING (ML)	INFILTRATION RATE (CM/SEC)
30	60	6.59E-05
90	150	8.23E-05
170	230	9.47E-05

WETLANDS DRAINAGE AND WETLANDS TESTS

SITE NAME: BODM

WET RAIN		
TEST START DATE AND TIME	TEST START TIME (HOUR)	TEST START DATE (MM/DD/YY)
12:00 PM	12	05/05/05
01:00 PM	01	05/05/05
02:00 PM	02	05/05/05

WET RAIN		
TEST START DATE AND TIME	TEST START TIME (HOUR)	TEST START DATE (MM/DD/YY)
03:00 PM	03	05/05/05
04:00 PM	04	05/05/05
05:00 PM	05	05/05/05

HELENA LANDFILL
DOUBLE RING INFILTRMETER TESTS

SITE NAME: RPDR-2

DRY RUN

TIME SINCE TEST START (MINUTES)	VOLUME ADDED TO INNER RING (ML)	INFILTRATION RATE (CM/SEC)
15	350	7.69E-04
30	10	2.20E-05
60	410	4.50E-04

WET RUN

TIME SINCE TEST START (MINUTES)	VOLUME ADDED TO INNER RING (ML)	INFILTRATION RATE (CM/SEC)
30	270	2.96E-04
90	600	3.29E-04
172	730	2.93E-04

WETLAND DISTINCTION TEST

SITE NAME: [REDACTED]

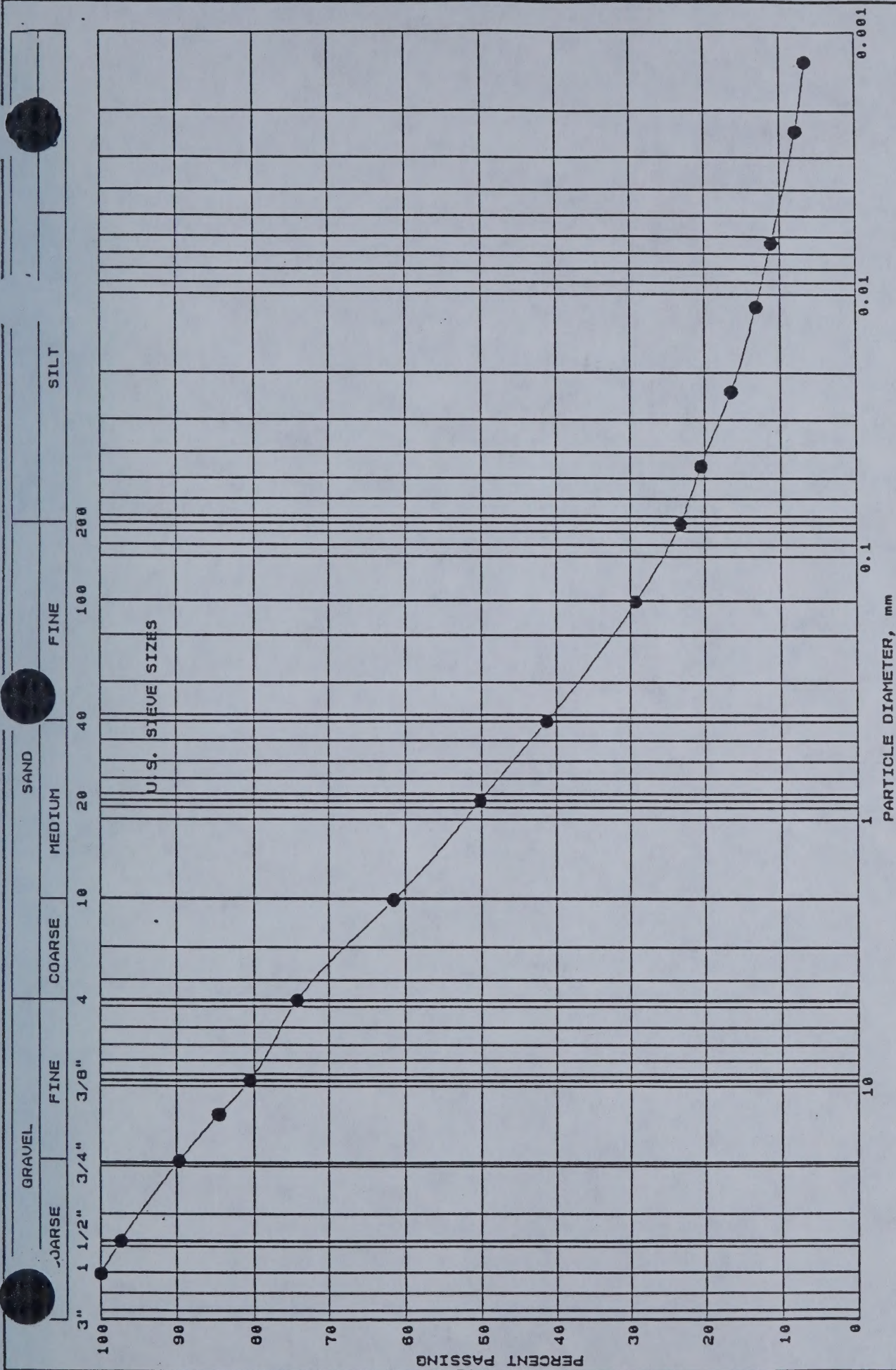
DATE: [REDACTED]

TEST START DATE	TEST END DATE	TEST START TIME	TEST END TIME
10/10/2010	10/10/2010	08:00	12:00
10/10/2010	10/10/2010	13:00	17:00
10/10/2010	10/10/2010	18:00	22:00

WETLAND

TEST START DATE	TEST END DATE	TEST START TIME	TEST END TIME
10/10/2010	10/10/2010	08:00	12:00
10/10/2010	10/10/2010	13:00	17:00
10/10/2010	10/10/2010	18:00	22:00

GRAIN SIZE ANALYSIS CURVE



USDA Classification

% GRAVEL: 39.0
 % SAND: 40.0
 % SILT: 13.5
 % CLAY: 7.5
 Class: Gravely Sandy Loam

PROJECT NO.: BHD-91-089L

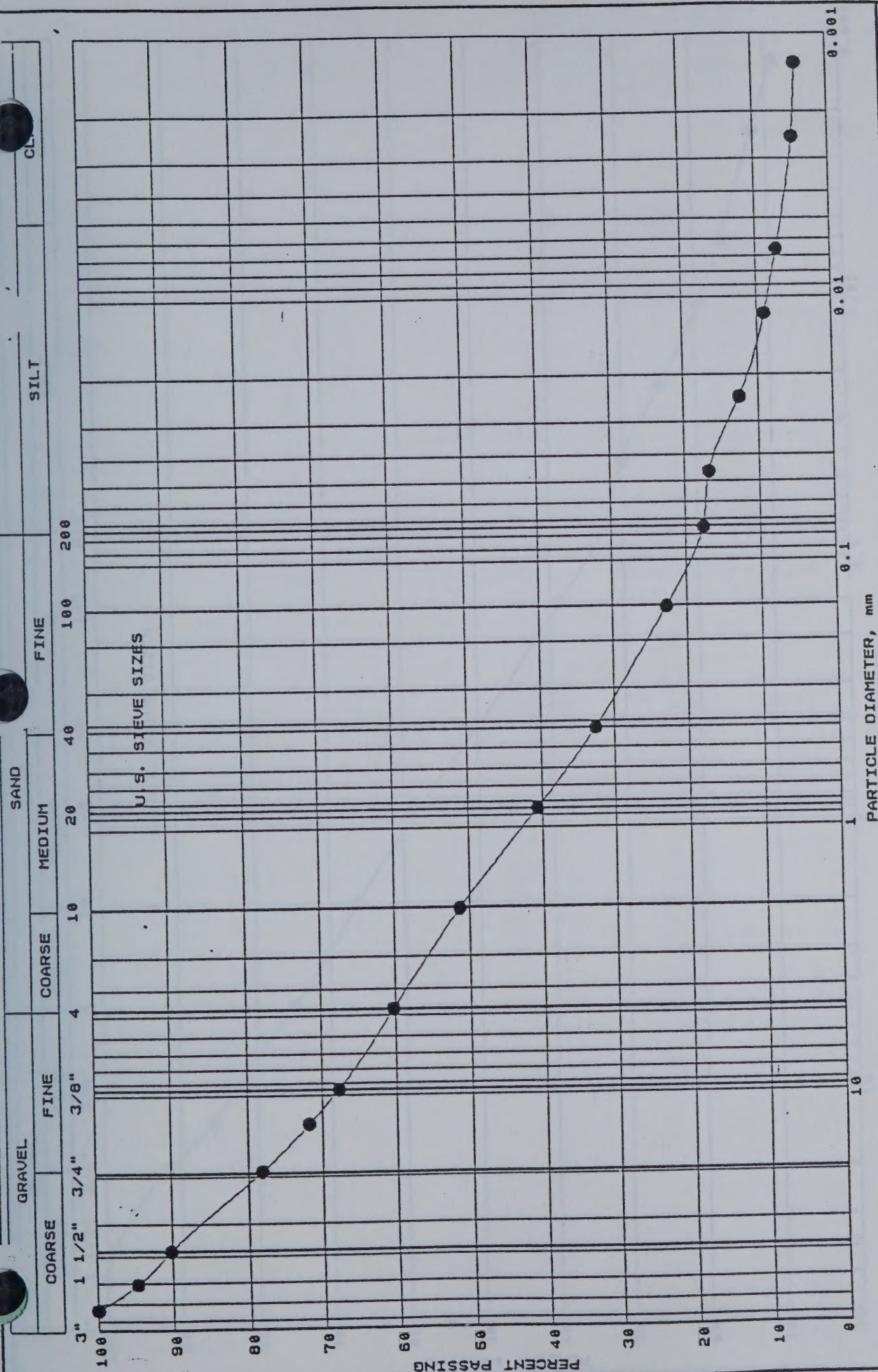
Helena Landfill Project

Helena, MT.

SAMPLE NO.: HL9105-B (1540/1550)

BRAUN
 INTERTEC

GRAIN SIZE AT .01% STS CURVE



PARTICLE DIAMETER, mm

USDA Classification

% GRAVEL:	48.0
% SAND:	36.0
% SILT:	12.5
% CLAY:	4.5
Class:	Gravelly

PROJECT NO.: BHD-91-089L

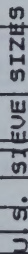
Helena Landfill Project
Helena, MT.

SAMPLE NO.: HL9105-A (1500)

BRAUN

INTERTEC

CLAY



% GRAVEL:	34.0
% SAND:	35.0
% SILT:	20.0
% CLAY:	11.0
Class:	Gravelly

BRAUN — **INTERTEC**



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BRAUN
ENGINEERING TESTING
OF MONTANA, INC.

Quality Services Since 1957

Age Rd., P.O. Box 30697, Billings, MT 59107-0697 — 406 / 652-3930

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Hibbing	Montana
St. Paul	Billings
	Bozeman
	Illinois
	Chicago

LABORATORY PERMEABILITY TEST (FALLING HEAD)

Date: December 1, 1989

Project: B89-212 LABORATORY TESTING
Permeability, Land Fill
Helena, MT

Reported To: Hydrometrics, Inc.
Attn: Daniel E. March
2727 Airport Road
Helena, MT 59601

Copies:

SAMPLE DATA:

Sample No. 1 Location: Depth:
Description: Visual: CLAYEY SAND, coarse grained, non-slightly plastic
LL: -- PL: -- PI: -- % Passing #200: -- % Passing 0.002 mm: --
Unified Classification: -- Textural Classification:
Maximum Dry Density (ASTM D 698): $114\frac{1}{2}$ pcf Optimum Moisture Content: 15 %
Sampled By: -- Natural Moisture Content: -- %

SPECIMAN DATA:

Molding MC: 17.8 % Dry Density: $108\frac{1}{2}$ pcf Relative Compaction: 95 %
Sample Diameter: 7.29 cm Height: 10.1 cm Cross-Section Area: 41.74 cm^2
Standpipe Area: 0.419 cm^2 Confining Pressure: 7.8 psi

TEST RESULTS:

Run	Initial Head, cm.	Final Head, cm.	Time, sec.	Permeability	
				cm/sec	ft/min
3	176.6	80.6	11,820	6.7×10^{-6}	
4	172.7	82.6	13,680	5.5×10^{-6}	
5	179.7	67.3	18,900	5.3×10^{-6}	
Average				5.8×10^{-6}	1.1×10^{-5}

REMARKS:



BRAUN ENGINEERING TESTING
OF MONTANA, INC.

Nathan P. Boeshans
Nathan P. Boeshans
Project Engineer

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ENGINEERING TESTING
OF MONTANA, INC.

BRAN

100-111 LABORATORY TEST RESULTS REPORT

LABORATORY TEST RESULTS REPORT

The December 1, 1988

James W. Thompson, Inc.
1700 Airport Road
Helena, MT 59601

100-111 LABORATORY TEST RESULTS REPORT
Permanently, Lead 721
Helena, MT

Customer: James W. Thompson, Inc.
Location: 1700 Airport Road, Helena, MT 59601
Project: 100-111 LABORATORY TEST RESULTS REPORT
Test Results: 100-111 LABORATORY TEST RESULTS REPORT
Test Results: 100-111 LABORATORY TEST RESULTS REPORT

Test Results: 100-111 LABORATORY TEST RESULTS REPORT
Test Results: 100-111 LABORATORY TEST RESULTS REPORT
Test Results: 100-111 LABORATORY TEST RESULTS REPORT

Test Results	Test Results	Test Results	Test Results	Test Results
100-111	100-111	100-111	100-111	100-111
100-111	100-111	100-111	100-111	100-111
100-111	100-111	100-111	100-111	100-111
100-111	100-111	100-111	100-111	100-111



BRAN ENGINEERING TESTING
OF MONTANA, INC.
Helena, MT 59601
Project Engineer

APPENDIX E.

METHANE INFORMATION

ALPHABETIC

RESEARCH REPORT

Dear Sir:

The following letter is to inform you of a condition at and peripheral to the City of Helena Landfill. During the natural breakdown of landfilled refuse, methane gas is formed. This methane can create explosive conditions and a low oxygen environment in sub-grade structures and excavations. Even though the levels of methane do not appear to be of concern in the landfill area, the City of Helena believes you should be aware of the potential problem and exercise precautionary measures when servicing any underground utilities or excavating in the vicinity of the landfill.

In the recent past, the City has monitored and sampled in numerous areas in and near the landfill. The results indicate that methane concentrations in monitoring wells and structures are well below the lower explosive limit and that these low concentrations of methane diminish a short distance from the landfilled area. However, we recommend monitoring oxygen and methane levels in any excavations, or when working in any sub-grade structures in or directly adjacent to the City landfill.

The City of Helena Fire Department is continuing to closely monitor this situation and should you have any questions we would be glad to be of assistance.

Sincerely,

Richard Nisbet, P.E.
Director of Public Works

RN:kab

The following is a list of the names of the persons who have been named in the report of the committee on the subject of the proposed amendment to the constitution of the city of New York, as passed by the city council on the 10th day of March, 1897.

In the report of the committee on the subject of the proposed amendment to the constitution of the city of New York, as passed by the city council on the 10th day of March, 1897, the following names are mentioned:

The following is a list of the names of the persons who have been named in the report of the committee on the subject of the proposed amendment to the constitution of the city of New York, as passed by the city council on the 10th day of March, 1897.

Report of the Committee on the Subject of the Proposed Amendment to the Constitution of the City of New York, as Passed by the City Council on the 10th Day of March, 1897.



ENERGY LABORATORIES, INC.

P.O. BOX 30916 • 1107 SOUTH BROADWAY • BILLINGS, MT 59107-0916 • PHONE (406) 252-6325
FAX (406) 252-6069 • 1-800-873-5227

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Steve Downs
2727 Airport Road
Helena, MT 59601

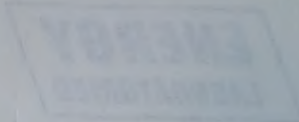
LAB NO.: 91-26557
DATE: 08/02/91 da

NATURAL GAS ANALYSIS REPORT

Helena Landfill
HL9107-1A
Sampled 07/23/91 @ 0930
Submitted 07/25/91

CHROMATOGRAPH ANALYSIS

<u>Constituent</u>	<u>Volume, %</u>
Oxygen	20.86 21
Nitrogen	77.72 78
Carbon dioxide	1.12 1
Hydrogen Sulfide	0.30
Methane	0.00
Ethane	0.00
Propane	0.00
Isobutane	0.00
N-Butane	0.00
Isopentane	0.00
N-Pentane	0.00
Hexanes plus	0.00
Totals	100.00



ENERGY LABORATORIES, INC.
PO BOX 2085 • 107 SOUTH BROADWAY • SUITE 207 • WILMINGTON, DE 19801-2085
TEL 302 438-1234 • FAX 302 438-1235

LABORATORY REPORT

LAB NO: 01-000001
DATE: 06/03/01

TO: HYDROCARBON
FROM: Steve Davis
2727 Airport Road
Bellevue, MT 59601

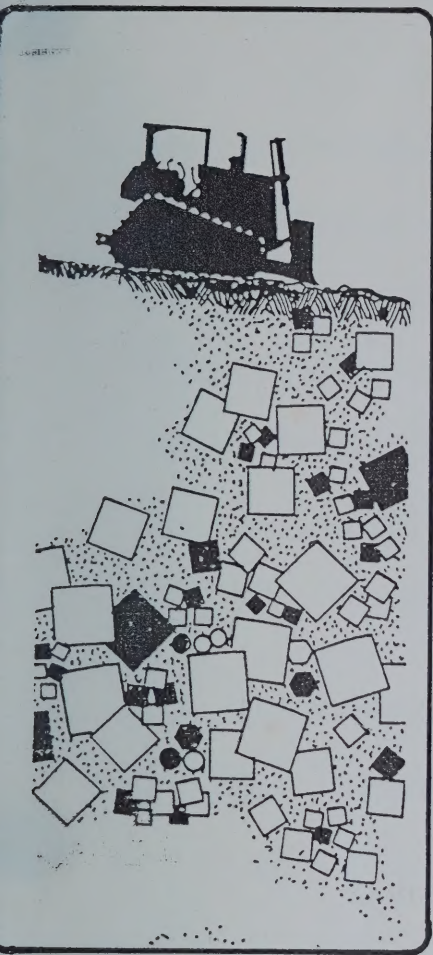
NATURAL GAS ANALYSIS REPORT

Helena Landfill
MS107-7A
Sampled 07/23/01 @ 0930
Submitted 07/23/01

CHROMATOGRAPHY ANALYSIS

Component	Volume %
Oxygen	0.00
Nitrogen	0.00
Carbon dioxide	0.00
Hydrogen sulfide	0.00
Methane	99.99
Ethane	0.00
Propane	0.00
Isobutane	0.00
n-Butane	0.00
Isopentane	0.00
n-Pentane	0.00
Hexanes plus	0.00
Total	100.00





Helena Landfill Closure Plan

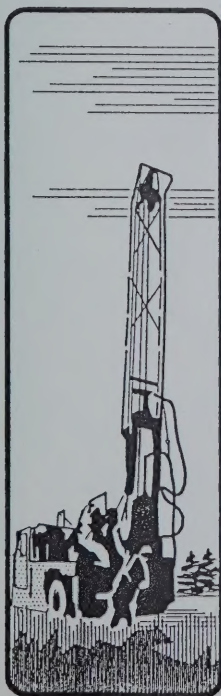
Submitted To:

Montana Department of Health
and Environmental Sciences

Submitted By:

City of Helena

Helena, Montana



Prepared By:

Hydrometrics, Inc.

Consulting Scientists and Engineers
Helena, Montana 59601

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Submitted to:

Montana Department of Health and
Environmental Sciences
Solid and Hazardous Waste Bureau
Cogswell Building
Helena, MT 59620

By:

City of Helena
316 North Park
Helena, MT 59620

Prepared by:

Hydrometrics, Inc.
2727 Airport Road
Helena, MT 59601

September 1991

HELENA LANDFILL CLOSURE PLAN

Submitted to:

Montana Department of Health and
Environmental Sciences
Solid and Hazardous Waste Division
Cargill Building
Helena, MT 59620

By:

City of Helena
316 North Park
Helena, MT 59620

Prepared by:

Hydroscience, Inc.
317 Airport Road
Helena, MT 59601

September 1991

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1.1 OPERATING HISTORY OF HELENA LANDFILL

The City of Helena Landfill is located east of Carroll College, west of Memorial Park, and North of Lyndale Avenue (Figure 1.1). The landfill encompasses about 37 acres of active and inactive landfill areas. The landfill was activated in the late 1800s when open

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HELENA LANDFILL CLOSURE PLAN

1.0 INTRODUCTION

This closure plan for the City of Helena Landfill is designed to meet all requirements set forth by the State of Montana in the Administrative Rules of Montana, Title 16, Chapter 14 - Solid Waste Management, Sub-chapter 5 - Refuse Disposal; and Sub-chapter 7 - Proposed Groundwater Monitoring Rules for Landfills in Montana. These regulations are also outlined in the Montana Department of Health and Environmental Sciences (MDHES), Solid and Hazardous Waste Bureau's document of April 3, 1991, entitled "Class II Landfill Closure Requirements and Recommendations".

The final closure date of the City of Helena Landfill is dependant on opening of the new Lewis and Clark County "Site E" Landfill which is in the permitting process at this time. Due to the uncertainty of the opening date of the new landfill, the final closure date for the City of Helena Landfill cannot be given. The City of Helena plans to operate under an interim closure for this period and will coordinate all final closure activities with the MDHES at the appropriate time.

1.1 OPERATING HISTORY OF HELENA LANDFILL

The City of Helena Landfill is located east of Carroll College, west of Memorial Park, and North of Lyndale Avenue (Figure 1.1). The landfill encompasses about 37 acres of active and inactive landfill areas. The landfill was activated in the late 1800s when open

HELENA LANDFILL CLOSURE PLAN

1.0 INTRODUCTION

This closure plan for the City of Helena Landfill is designed to meet all requirements set forth by the State of Montana in the Administrative Rules of Montana. This is Chapter 12 - Solid Waste Management, Subchapter 2 - Rules, Chapter 12-200, and Subchapter 7 - Proposed Groundwater Monitoring Rules for Landfills in Montana. These regulations are also outlined in the Montana Department of Health and Environmental Sciences (MDHES) Solid and Hazardous Waste Bureau's document in April 1991, entitled "Plan to Landfill Closure Requirements and Recommendations".

The final closure date of the City of Helena Landfill is dependent on opening of the new Land and Clark County San E. Landfill which is in the permitting process at this time. Due to the uncertainty of the opening date of the new landfill, the final closure date for the City of Helena Landfill cannot be given. The City of Helena plans to operate under an interim closure for the period and will coordinate all final closure activities with the MDHES at the appropriate time.

1.1 OPERATING HISTORY OF HELENA LANDFILL

The City of Helena Landfill is located east of Canyon College, west of Memorial Park, and north of Lyndale Avenue (Figure 1.1). The landfill encompasses about 37 acres of active and inactive landfill areas. The landfill was activated in the late 1960s when open

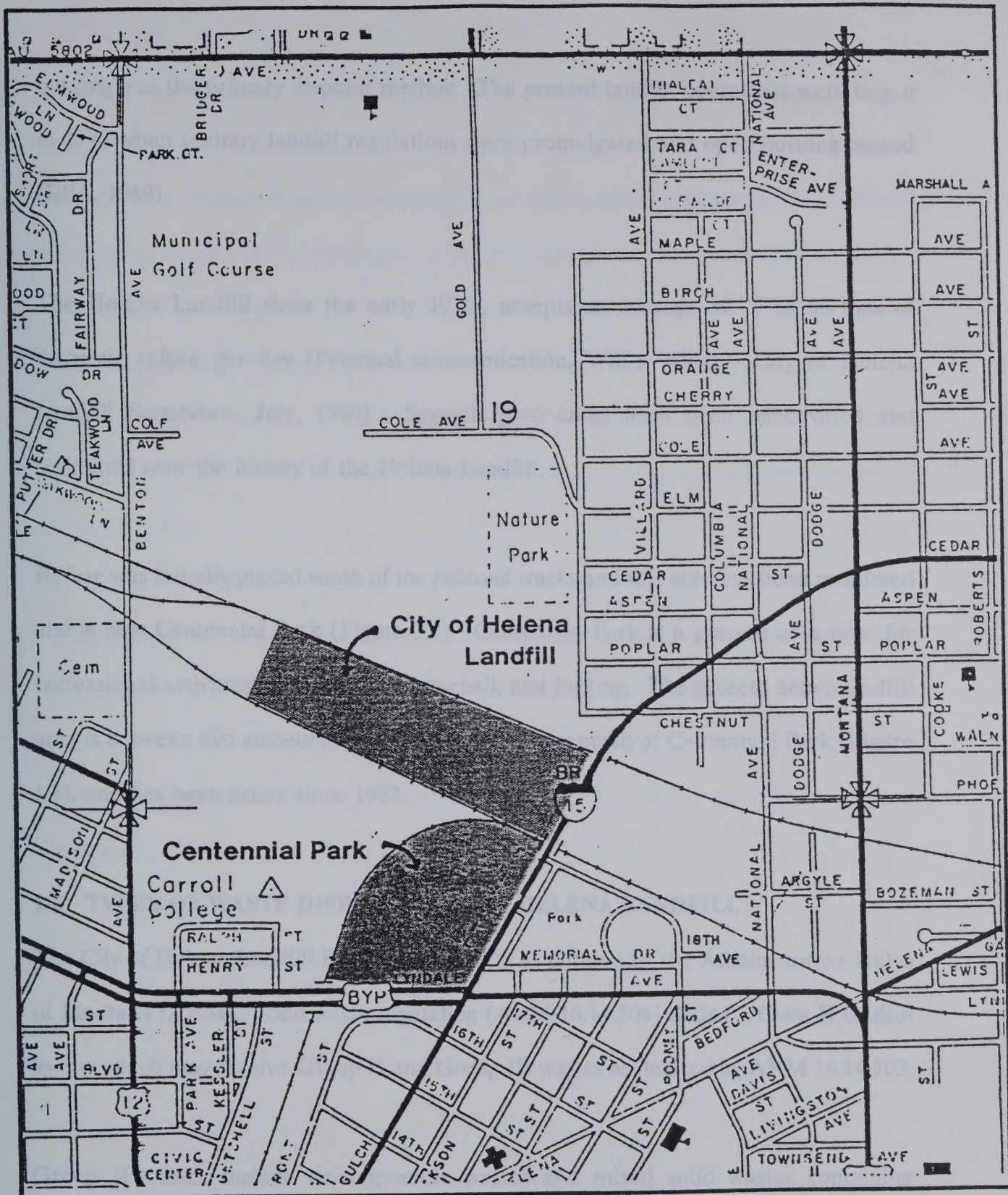
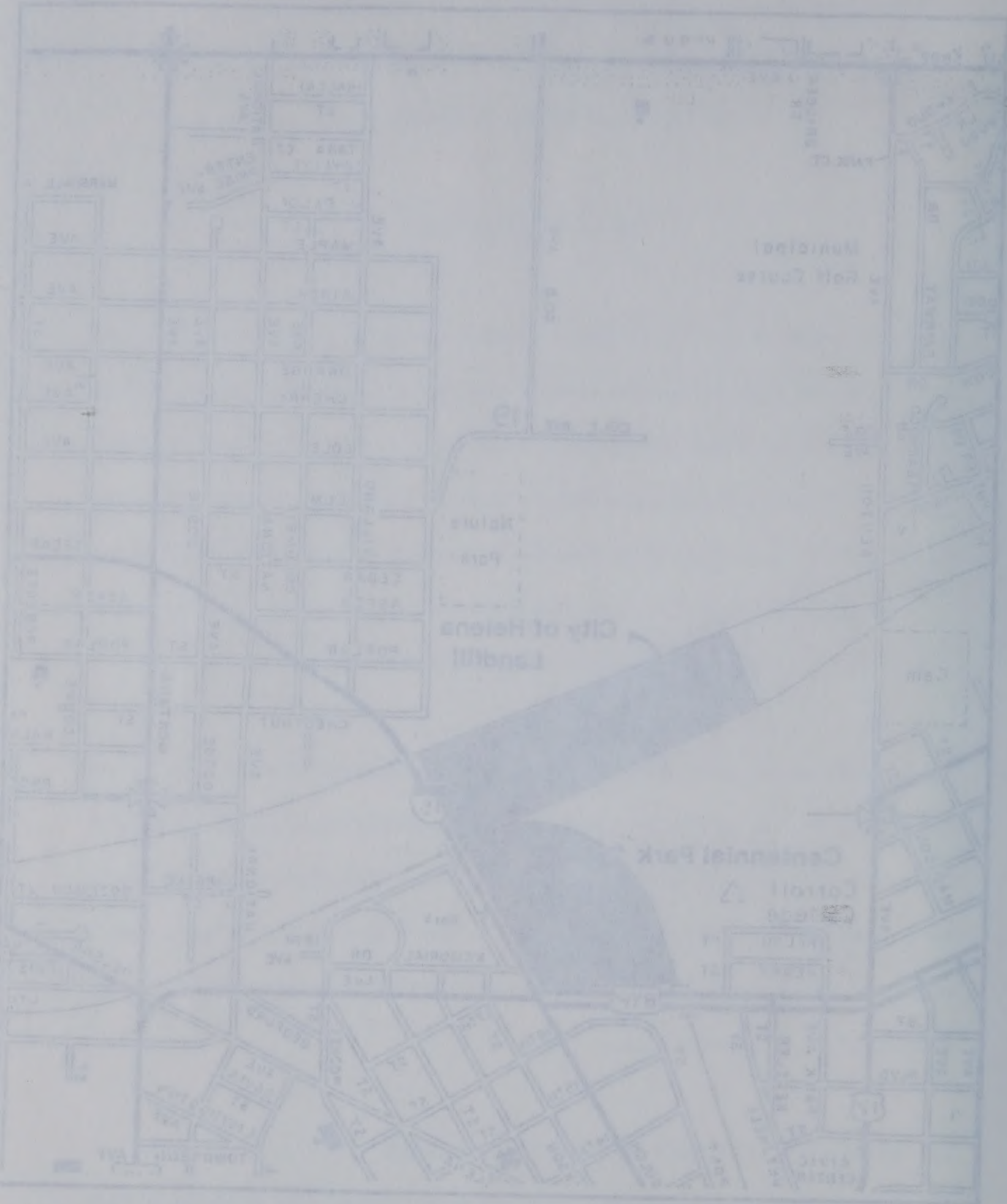


Figure 1.1: City of Helena Landfill
Location Map



Scale: 1" = 1000 feet



Figure 1: City of Helena Landfill
Location Map

burning was the primary disposal method. The present landfill operations were begun in 1970 when sanitary landfill regulations were promulgated and open burning ceased (EPA, 1989).

The Helena Landfill since the early 1970s, accepts an average of 75 to 80 tons of domestic refuse per day (Personal communication, Willie Miller - City of Helena Landfill Supervisor, July, 1990). Several filled areas have been deactivated and reclaimed over the history of the Helena Landfill.

Refuse was initially placed south of the railroad tracks and this area has been reclaimed and is now Centennial Park (Figure 1.1). Centennial Park is a grassed area used for recreational activities such as soccer, baseball, and jogging. The present active landfill area is between two east-west running railroad tracks north of Centennial Park (Figure 1.1), and has been active since 1982.

1.2 TYPES OF WASTE DISPOSED AT THE HELENA LANDFILL

The City of Helena Landfill is a Class II landfill as defined by the Administrative Rules of Montana (ARM). Solid waste regulation (ARM 16.14.504) define a Class II landfill as one which may receive Group II and Group III wastes as defined by ARM 16.14.503.

Group II wastes include decomposable wastes and mixed solid wastes containing decomposable material but exclude hazardous wastes. Examples include, but are not limited to municipal and domestic wastes such as garbage and putrescible organic

... burning was the primary disposal method. The present landfill operations were begun in 1970 when sanitary landfill regulations were promulgated and were located around (EPA 1987).

The Federal Landfill since the early 1970s occupies an average of 75 to 80 tons of domestic refuse per day (Personal communication, Willie Miller - City of Helena, Landfill Supervisor, July, 1990). Several third areas have been identified and included over the history of the Federal Landfill.

Refuse was initially placed south of the railroad tracks and then the first landfill and is now Commercial Park (Figure 1.1). Commercial Park is a general area used for recreational activities such as tennis, baseball, and soccer. The present sanitary landfill site is between two commercial parking areas south of Commercial Park (Figure 1.1) and has been active since 1982.

1.1 TYPES OF WASTE DEPOSITED AT THE DELTA LANDFILL

The City of Helena Landfill is a Class II landfill as defined by the Administrative Rules of Montana (ARM). Such waste regulation (ARM 10.14.304) defines a Class II landfill as one which may receive Group II and Group III wastes as defined by ARM 10.14.303.

Group II wastes include nonhazardous wastes and mixed solid waste containing combustible material but exclude petroleum wastes. Examples include but are not limited to municipal and domestic wastes such as garbage and household refuse.

materials, paper, cardboard, cloth, glass, metal, plastics, street sweepings, yard and garden wastes, digested sewage treatment sludges, water treatment sludges, ashes, dead animals, offal, discarded appliances, abandoned automobiles, and hospital and medical facility wastes, provided that infectious medical wastes have been sterilized or safely contained to prevent the danger of disease; and commercial and industrial wastes such as packaging materials, liquid or solid industrial process wastes which are chemically or biologically decomposable, crop residues, manure, chemical fertilizers and emptied pesticide containers which have been triple rinsed or processed by methods approved by the department.

LI GEOLOGIC SETTING

Group III wastes include wood wastes and non-water soluble, essentially inert solids. Examples include, but are not limited to inert solid waste such as brick, dirt, rock and concrete; wood materials, brush, lumber, and vehicle tires; and industrial mineral wastes which are essentially inert and non-water soluble, and do not contain hazardous waste constituents.

The Helena Landfill is at the mouth of Last Chance Gulch at the southern edge of the Helena Valley. The gulch in this area is underlain with alluvial deposits of Quaternary and Tertiary geological age that are in geological contact with igneous bedrock at Carroll College and limestone bedrock beneath the U.S. National Guard Armory and YMCA buildings adjacent to Last Chance Gulch. The alluvial stream and fan deposits are indistinguishable and are composed of layers, lenses and mixtures of unconsolidated clay, silt, sand, gravel and cobbles (Coffin, 1971). The alluvial material is variable in lithology with limestone and dolomite clasts from the Precambrian Helena Dolomite Formation,

unwashed paper, cardboard, cloth, glass, metal, plastic, metal swastika, yard and garden waste, digested sewage treatment sludge, water treatment sludge, animal dead animals, offal, discarded appliances, abandoned automobiles, and hospital and medical facility wastes, provided that infectious medical wastes have been sterilized or safely contained to prevent the danger of disease; and commercial and industrial wastes such as packaging materials, liquid or solid industrial process wastes which are chemically or biologically decomposable, crop residues, manure, chemical fertilizers and unguished pesticides containers which have been triple rinsed or processed by methods approved by the department.

Group III wastes include solid waste and non-water soluble essentially inert solids. Examples include, but are not limited to inert solid waste such as brick, dirt, rock and concrete, wood materials, brush, lumber and vehicle tires, and various industrial wastes which are essentially inert and non-water soluble, and do not contain hazardous waste components.

2.0 HYDROGEOLOGY OF THE HELENA LANDFILL AREA

Several studies evaluating soils, hydrogeology and water quality in the Helena Landfill area have been conducted in recent years. These studies include EPA Field Investigation Team studies in 1987 and 1989, Hydrometrics, Inc.'s studies in 1982, 1983 and 1990, and F and M Consultants' study in 1982. The United States Geological Survey has also conducted several studies of the geology and hydrogeology of the Helena Valley. All of these studies have been considered in the preparation of this closure plan.

2.1 GEOLOGIC SETTING

The City of Helena Landfill is located at the edge of the Helena Valley near the base of Mount Helena. The hills and mountains peripheral to the Helena Valley are folded and faulted igneous, sedimentary and metamorphic rocks that range in geological age from Precambrian to Tertiary (Wilke and Coffin, 1973).

The Helena Landfill is at the mouth of Last Chance Gulch at the southern edge of the Helena Valley. The gulch in this area is underlain with alluvial deposits of Quaternary and Tertiary geological age that are in geological contact with igneous bedrock at Carroll College and limestone bedrock beneath the U.S. National Guard Armory and YMCA buildings adjacent to Last Chance Gulch. The alluvial stream and fan deposits are indistinguishable and are composed of layers, lenses and mixtures of unconsolidated clay, silt, sand, gravel and cobbles (Coffin, 1971). The alluvial material is variable in lithology with limestone and dolomite clasts from the Precambrian Helena Dolomite Formation,

and clasts of intrusive igneous rocks of Cretaceous age being common. The former has been uplifted and exposed to the south of Helena, and the latter is present as an elevated bedrock hill in the Carroll College area. Alluvial fan and stream deposits were probably deposited by an interconnecting network of paleochannels which resulted in the heterogeneous alluvium at the mouth of Last Chance Gulch.

In the vicinity of the Bill Roberts Golf Course (just north of the landfill), the Quaternary alluvium has been extensively placer mined for gold. The dredge tailings vary in thickness from 25 to 50 feet and are underlain by unconsolidated to semi-consolidated sediments of Tertiary age and by alluvium to deep to dredge. The Tertiary sediments vary in thickness from many hundreds of feet in the central Helena Valley to relatively thin deposits along the valley's edges (Hydrometrics, 1982). These Tertiary sediments are underlain by the Precambrian Helena Dolomite Formation and possibly the Empire and Spokane Formations. The Helena Dolomite is a siliceous dolomite with subordinate limestone. Wells located just north of Carroll College are completed in this formation and yield only small quantities of water. An irrigation well drilled in the Bill Roberts Golf Course encountered a green argillite at a depth of about 200 feet. This argillite is likely a Precambrian age rock of the Empire and Spokane Formation, or the Marsh Formation. The bedrock mound that forms the hill on which Carroll College sits an igneous intrusive (diorite porphyry) which intruded upward through the older formations.

The unconsolidated alluvium varies in texture from a silty or clayey sand to medium or coarse-grained sand containing gravel and cobbles. Textural variations are likely due

and class of massive igneous rocks of Cretaceous age being common. The former has been uplifted and exposed to the south of Hinton, and the latter is present as an elevated bedrock hill in the Carroll College area. Aerial and ground deposits were probably deposited by an interconnecting network of paleochannels which resulted in the heterogeneous character of the south of Lake Charles Basin.

In the vicinity of the Hill Roberts Golf Course (just south of the hill), the Cretaceous sediment has been extensively quarried for gravel. The strata dipping very to the west from 25 to 30 feet and are underlain by unconformable to well-consolidated sediment of Tertiary age and by alluvium to deep to the top. The Tertiary sedimentary rocks in the west from many hundreds of feet in the central Hinton Valley to relatively thin deposits along the valley's edges (Hyatt, 1962). These Tertiary sediments are underlain by the Precambrian Hinton Dolomite Formation and possibly the Eureka and Spokane Formations. The Hinton Dolomite is a siliceous dolomite with subordinate limestone. Wells located just south of Carroll College are completed in this formation and yield only small quantities of water. An irrigation well drilled in the Hill Roberts Golf Course encountered a green argillite at a depth of about 30 feet. This argillite is likely a Precambrian age rock of the Eureka and Spokane Formations or the Marsh Formation. The bedrock mound that forms the hill on which Carroll College sits is a typical massive (igneous) granite (which intruded upward through the older formations).

2.2 HYDROGEOLOGY OF THE HELENA LANDFILL AREA

Groundwater in the landfill area occurs both in the alluvium and the underlying bedrock. North of the landfill, groundwater occurs in dredge piles left by historic mining at the mouth of Last Chance Gulch, and in the semi-consolidated Tertiary sediments. These sediments are heterogenous in nature.

Groundwater flow in the study area is generally to the north and northwest with an average gradient of about 0.05 ft/ft. Exhibit 1 shows a potentiometric surface map of the alluvial system. Hydrometrics (1982) estimated the groundwater flow rate through the alluvium underlying the landfill to be approximately 28 gallons per minute. This flow rate is based on a hydraulic conductivity of 100 gpd/ft² (F and M Consultants, 1982), an average saturated thickness of 20 feet, and an average valley width of 400 feet. Assuming a porosity of 25% for the alluvium, the average groundwater velocity in the vicinity of the landfill is estimated to be 2.68 ft/day. Based on additional data obtained by Hydrometrics, Inc. in 1990, these earlier velocity and flow estimates could be as much as an order of magnitude low. Table 2.1 shows hydrogeological characteristics of selected sites in the landfill area. At these sites, transmissivity (the ability to transmit water) of the alluvium ranges at these sites from 1,680 gpd/ft to 33,000 gpd/ft (Hydrometrics, 1990). This broad range is due to the heterogeneous nature of the alluvium in the landfill area.

The unconsolidated alluvium varies in texture from a silty or clayey sand to medium or coarse-grained sand containing gravel and cobbles. Textural variations are likely due

1.1 HYDROGEOLOGY OF THE HELIX LAKE AREA

Groundwater in the landfill area occurs both in the alluvium and in the underlying bedrock. North of the landfill, groundwater occurs in bedrock fractures and is present within the aquifer of Lake Champlain, and in the sedimentary basins. These sediments are heterogeneous in nature.

Groundwater flow in the study area is generally to the north and northeast with an average gradient of about 100 ft/ft. English (1987) shows a potentiometric surface map of the landfill system. Hydrometrix (1987) estimated the groundwater flow rate through the landfill as being the landfill to be approximately 25 gpm per minute. This flow rate is based on a hydraulic conductivity of 100 gpm/ft and a 21 ft thickness. (1987) an average saturated thickness of 20 ft and an average velocity within of 20 ft. Assuming a porosity of 15% for the alluvium, the average flow rate within the vicinity of the landfill is estimated to be 1.0 ft/day. The above alluvium data obtained by Hydrometrix Inc. in 1980 show rather variable and low estimates could be as much as an order of magnitude less. Table 1.1 shows hydrogeological characteristics of selected sites in the landfill area. At these sites, water levels (the depth to water) of the alluvium range at these sites from 1,600 gpm/ft to 2,000 gpm/ft (Hydrometrix, 1990). This broad range is due to the heterogeneous nature of the alluvium in the landfill area.

The consolidated alluvium varies in texture from a silt or clayey sand to medium or coarse-grained sand containing gravel and cobbles. Textural variations are likely due

Table 2.1: Hydrogeologic Characteristics Of Selected Sites

WELL OR PIT	GEOLOGIC MATERIAL	TRANSMISSIVITY	HYDRAULIC CONDUCTIVITY
GOLF COURSE TW-1	Poorly sorted alluvium - sand, gravel, cobbles and minor clay	7920 gpd/ft	2x10-3 cm/sec
GOLF COURSE TW-3	Semi-consolidated bedrock "Caliche"	1680 gpd/ft	7x10-4 cm/sec
South Pit *	Disturbed stream channel	11,000 gpd/ft	
North Pit *	Coarse sandy gravel	33,000 gpd/ft	

* From Robert Peccia and Associates (1982) Study
For Bill Roberts Municipal Golf Course

MAP LOCATION	APPROX. SPECIFIC CAPACITY	MAP LOCATION	APPROX. SPECIFIC CAPACITY
1	0.36	36	1
5	1.25	37	0.3
6	0.41	38	0.36
7	0.81	39	1
13	0.31	40	1
15	0.24	41	0.53
16	0.32	42	0.66
19	0.5	43	0.3
20	0.43	44	0.62
21	4.28	54	0.6
24	0.18	56	3.7
26	0.008	62	0.42
27	0.01	65	0.36
28	0.07	67	0.29
29	0.07	73	0.14
30	0.47	75	1
31	0.15	78	0.67
35	0.56		

NOTE: Specific Capacities were calculated from short term pumping test data and are only approximations.

Table 1.1: Hydrogeologic Characteristics Of Selected Sites

WELL OR PIT	GEOLOGIC MATERIAL	TRANSMISSIVITY	HYDRAULIC CONDUCTIVITY
GOLF COURSE TW-1	Heavily eroded silurian - sand, gravel, cobbles and siltstone clay	7000 ft/day	25000 cfs/ft
GOLF COURSE TW-2	Inter-bedded sandstone and shale	1000 ft/day	25000 cfs/ft
South 75*	Disrupted sandstone (shale)	11,000 ft/day	
North 75*	Coarse sandy gravel	32,000 ft/day	

* From Robert Potts and Associates (1985) Study For Bill Roberts (Municipal Golf Course)

MAP LOCATION	SP-2 SPECIFIC CAPACITY	MAP LOCATION	SP-2 SPECIFIC CAPACITY
1	0.75	30	1
2	1.1	31	0.3
3	0.9	32	0.3
4	0.9	33	1
5	0.3	34	0.3
6	0.3	35	0.3
7	0.3	36	0.3
8	0.3	37	0.3
9	0.3	38	0.3
10	0.3	39	0.3
11	0.3	40	0.3
12	0.3	41	0.3
13	0.3	42	0.3
14	0.3	43	0.3
15	0.3	44	0.3
16	0.3	45	0.3
17	0.3	46	0.3
18	0.3	47	0.3
19	0.3	48	0.3
20	0.3	49	0.3
21	0.3	50	0.3
22	0.3	51	0.3
23	0.3	52	0.3
24	0.3	53	0.3
25	0.3	54	0.3
26	0.3	55	0.3
27	0.3	56	0.3
28	0.3	57	0.3
29	0.3	58	0.3
30	0.3	59	0.3
31	0.3	60	0.3
32	0.3	61	0.3
33	0.3	62	0.3
34	0.3	63	0.3
35	0.3	64	0.3
36	0.3	65	0.3
37	0.3	66	0.3
38	0.3	67	0.3
39	0.3	68	0.3
40	0.3	69	0.3
41	0.3	70	0.3
42	0.3	71	0.3
43	0.3	72	0.3
44	0.3	73	0.3
45	0.3	74	0.3
46	0.3	75	0.3
47	0.3	76	0.3
48	0.3	77	0.3
49	0.3	78	0.3
50	0.3	79	0.3
51	0.3	80	0.3
52	0.3	81	0.3
53	0.3	82	0.3
54	0.3	83	0.3
55	0.3	84	0.3
56	0.3	85	0.3
57	0.3	86	0.3
58	0.3	87	0.3
59	0.3	88	0.3
60	0.3	89	0.3
61	0.3	90	0.3
62	0.3	91	0.3
63	0.3	92	0.3
64	0.3	93	0.3
65	0.3	94	0.3
66	0.3	95	0.3
67	0.3	96	0.3
68	0.3	97	0.3
69	0.3	98	0.3
70	0.3	99	0.3
71	0.3	100	0.3

NOTE: Specific Capacities were calculated from short term pumping test data and are only approximations.

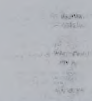
to the changing environment during deposition of the alluvium with the more coarse-grained materials associated with high energy outflows from Last Chance Gulch into the Ten Mile Creek drainage. As the groundwater moves out of the landfill area, to the north, the groundwater gradient flattens indicating more transmissive materials in this part of the valley.

Wells completed in bedrock southwest of the landfill exhibit much lower specific capacities (amount of water yield per foot of drawdown) than wells completed in the alluvium. Alluvial wells in the area are typically 60 to 100 feet deep, while bedrock wells are typically deeper than 250 feet. Water wells in and around the landfill area have been inventoried (Table 2.2) and are shown on Exhibit 1.

Semi-consolidated, alluvial deposits of Tertiary age were encountered north and west of the landfill during drilling of golf course irrigation well I-3 and monitoring well HL90-1 (Exhibit 1). These semi-consolidated deposits are less transmissive than the overlying, unconsolidated alluvium and are composed of calcite cemented sands and gravels sometimes referred to as "caliche".

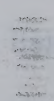
The thickness of the alluvium increases from a few feet near Lyndale Avenue (see Exhibit 1) to about 200 feet at golf course well I-3. Figure 2.1 is a hydrogeological cross-section based on monitoring well data from the northern landfill boundary area. A steeper groundwater gradient (slope of the water table) near the city storm drain indicates a possible recharge and subsequent mounding effect from water associated with

to the changing environment during deposition of the alluvium with the river course-
grained materials associated with high energy outflow from Lake Charles. Once into the
Tribal Creek drainage, the groundwater flows out of the landfill near to the
nearby the groundwater gradient pattern indicating more transverse materials in this
part of the valley.



Well completed in bottom corner of the landfill exhibit sand lower specific
resistance (amount of water field per foot of thickness) than wells completed in the
alluvium. Aerial wells in the area are typically 60 to 100 feet deep while bottom wells
are typically deeper than 250 feet. Water wells in and around the landfill are more
than 100 feet deep (Table 2.2) and are shown on Exhibit 1.

Some unconsolidated alluvial deposits of Tertiary age were encountered on the west of
the landfill during drilling of gas control system well 4-3 and monitoring well H-10-1
(Exhibit 1). These semi-consolidated deposits are less permeable than the overlying
unconsolidated alluvium and are composed of calcareous cemented sands and gravels
sometimes referred to as "caliche".



The thickness of the alluvium increases from a few feet near the river to
Exhibit 1) to about 100 feet at gas control well 4-3. Figure 2.1 is a hydrogeological cross-
section based on monitoring well data from the northern landfill boundary area. A
steep groundwater gradient (slope of the water table) near the city shore clearly
indicates a possible recharge and subsequent mounding effect from water associated with

Table 2.2: Helena Landfill Area Well Inventory

NUMBER	ADDRESS	OWNER	DEPTH	PERFORATED ZONE
1	230 Meadow Dr.	G. Amestoy	100	---
2	233 Meadow Dr.	C. Colarchic	---	---
3	227 Greenwood	A. Holzwarth	---	44-64
4	5 Deborah Ct.	T. Johnson	100	---
5	350 Custer Ave.	S. Colvin	80	60-80
6	3119 Bridger	J. Garman	100	70-100
7	454 Vigilante	R. Stenquist	51	---
8	3107 Vigilante	C. Knutson	101	80-100
9	3130 Vigilante	C. Tielking	61	---
10	448 Russell	L. Peterman	---	---
11	472 Russell	J. Zimmerman	---	---
12	448 Paxon	M. Parriman	68	60-68
13	102 Oakwood	E. Johnson	118	78-118
14	104 Oakwood	K. Rogers	115	70-110
15	106 Oakwood	E. Darfler	140	90-140
16	3 Parr Court	C. Tilzey	65	54-64
17	105 Wedgewood	F. Robinson	---	---
18	108 Wedgewood	B. Hartman	---	---
19	119 Wedgewood	D. Clark	115	90-115
20	3 Terry Court	H. Peterson	120	80-120
21	146 Briarwood	R. Karp	52	12-52
22	154 Briarwood	R. Burger	---	---
23	114 Ridgewood	T. Berry	75	55-75
24	1130 Waukesha	E. Johnson	180	100-180
25	1703 Waukesha	M. Carmichael	---	---
26	932 Peosta	G. Daly	300	---
27	1110 Peosta	S. McCann	360	---
28	1314 Peosta	M. Johnson	278	170-270
29	1331 Peosta	R. Guse	300	120-290
30	1611 Peosta	R. Brohman	135	---
31	1430 Brady	D. Gardner	101	75-95
32	1815 Brady	W. Routzahn	220	140-220
33	1317 Hudson	C. Engstedt	---	---
34	1325 Hudson	K. Erickson	118	78-118
35	1427 Broadwater Cir.	Broadwater Vill.	215	95-215
36	3203 Cooney	Kalamity Bros.	45	38-45
37	235 Anderson Blvd.	G. South	100	40-100
38	227 Anderson Blvd.	T. Tillo	100	40-100

--- Denotes information not found. Inventory is based on DNRC records and field investigation.

Table 2.2. Helium Landfill Area Well Inventory

NUMBER	ADDRESS	OWNER	DEPTH	PERFORATED ZONE
1	123 Main St.	G. Adams	100	---
2	123 Main St.	C. Adams	---	---
3	123 Main St.	A. Adams	---	11-14
4	123 Main St.	T. Adams	100	---
5	123 Main St.	S. Adams	80	61-62
6	123 Main St.	B. Adams	100	71-72
7	123 Main St.	R. Adams	81	---
8	123 Main St.	C. Adams	101	81-100
9	123 Main St.	C. Adams	81	---
10	123 Main St.	A. Adams	---	---
11	123 Main St.	T. Adams	---	---
12	123 Main St.	M. Adams	81	11-12
13	123 Main St.	E. Adams	115	78-79
14	123 Main St.	A. Adams	115	70-71
15	123 Main St.	E. Adams	110	80-110
16	123 Main St.	C. Adams	81	11-12
17	123 Main St.	R. Adams	---	---
18	123 Main St.	R. Adams	---	---
19	123 Main St.	T. Adams	115	60-115
20	123 Main St.	M. Adams	110	80-110
21	123 Main St.	A. Adams	81	11-12
22	123 Main St.	M. Adams	---	---
23	123 Main St.	E. Adams	78	41-78
24	123 Main St.	E. Adams	110	100-110
25	123 Main St.	M. Adams	---	---
26	123 Main St.	C. Adams	100	---
27	123 Main St.	S. Adams	100	---
28	123 Main St.	M. Adams	110	110-115
29	123 Main St.	R. Adams	110	110-115
30	123 Main St.	R. Adams	115	---
31	123 Main St.	E. Adams	101	51-52
32	123 Main St.	E. Adams	110	110-115
33	123 Main St.	C. Adams	---	---
34	123 Main St.	K. Adams	115	71-115
35	123 Main St.	E. Adams	115	61-115
36	123 Main St.	K. Adams	11	11-12
37	123 Main St.	G. Adams	100	100-105
38	123 Main St.	T. Adams	100	100-105

--- Entries indicate not found. Inventory is based on USGS records and field investigation.

Table 2.2: Helena Landfill Area Well Inventory

39	239 Anderson Blvd.	W. Kotan	82	58-82
40	2509 Teakwood	E. Hartman	70	50-70
41	124 Meadow	Strasko	73	53-73
42	112 Meadow	W. Hill	72	52-72
43	246 Brady	Frisch	80	40-80
44	1023 Peosta	Cumley	65	55-65
45	94 Oakwood	Hanson	116	---
46	320 Custer	Colvin	---	---
47	328 Custer	---	---	---
48	308 Custer	M. Barbeau	79	---
49	304 Custer	---	---	---
50	226 Custer	---	---	---
51	220 Custer	E. Hartze	64	---
52	Custer & Grn. Meadow	---	---	---
53	121 Dunbar	G. Kercher	---	---
54	122 Dunbar	S. Hitchcock	67	57-67
55	114 Dunbar	---	---	---
56	112 Dunbar	G. Francis	54	---
57	108 Dunbar	Bacon	---	---
58	106 Dunbar	---	---	---
59	100.102 Dunbar	B. Littlejohn	---	---
60	No Address - Trailers	---	---	---
61	78 Dunbar	J. Hayes	72	---
62	76 Dunbar	J. Bridges	80	60-80
63	110 Willow	G. Milairn	---	---
64	121 Willow	B. Bonogofsky	82	58-82
65	110 Willow	Pool	85	---
66	108 Willow	---	---	---
67	105 Willow	O'Neal	100	60-100
68	104 Willow	J. Creach	80-100	---
69	19 Willow	Horsecienda Hotel	---	---
70	11 Willow	Gardner	55	---
71	3204 Mitchell	Chamberlain	---	---
72	3208 Mitchell	Hall	---	---
73	3212 Mitchell	Tovey	72	52-72
74	3216 Mitchell	Allison	---	---
75	104 Reed	J. Creach	70	22-70
76	Trailer Court on Reed	---	---	---
77	115 Reed	---	---	---
78	120 Reed	W. Cole	50	42-50
79	SW Corner Grn Mdw/Reed	---	---	---
80	3280 Green Meadow	Trails West	---	---

--- Denotes information not found. Inventory is based on DNRC records and field investigation.

Table 12. Hobbs Lashell Area Well Inventory

50	3250 Green Member	(This Well)	---	---
79	SW Corner (in Midland)	---	---	---
77	112 East	W. 1st	50	42-50
76	112 East	---	---	---
75	104 East	---	---	---
74	104 East	---	---	---
73	104 East	---	---	---
72	104 East	---	---	---
71	104 East	---	---	---
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68	104 East	---	---	---
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44	104 East	---	---	---
43	104 East	---	---	---
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4	104 East	---	---	---
3	104 East	---	---	---
2	104 East	---	---	---
1	104 East	---	---	---
0	104 East	---	---	---

--- Denotes information not found; inventory is based on ENRC records and field investigation.

Table 2.2: Helena Landfill Area Well Inventory

81	3300 Green Meadow	G. M. Market	---	---
82	County Fairgrounds	Fairgrounds	---	---
83	610 W. Custer	AAA Car Wash	---	---
84	500 Cole Ave.	---	---	---
85	210 Harwood	Ralston	75	15-75
86	15 Reed	C. Bryant	72	---
HL-90-1	---	City of Helena	60	40-60
HL-90-2	---	City of Helena	68	60-68
HL-90-3	---	City of Helena	79	59-79
83-7	---	City of Helena	40	32-37
82-1	---	City of Helena	40	14-34
82-2	---	City of Helena	43	23-43
82-3	---	City of Helena	83	43-83
82-4	---	City of Helena	79	44-74
HL-1	---	EPA	---	---
HL-2	---	EPA	---	---
HL-5	---	EPA	---	---
HL-6	---	EPA	---	---
HL-7	---	EPA	---	---
EPA1	---	EPA	54.5	39.5-54.5
EPA2	---	EPA	55.1	40.1-55.1
EPA3	---	EPA	95	85-95
EPA4	---	EPA	76.2	66.2-76.2
I-1	---	Golf Course	146	35-95
I-2	---	Golf Course	---	---
I-3	---	Golf Course	220	71-170 (Zones)
I-4	---	Batch Fields	156	60-156
I-5	---	Carroll College	550	100-550
I-6	---	Carroll College	320	100-320
I-7	---	Golf Course	---	---

--- Denotes information not found. Inventory is based on DNRC records and field investigation.

Table 2.3: Helicon Landing Area Wolf Inventory

1-1	---	Wolf Camp	---	---
1-2	---	Carroll College	200	---
1-3	---	Carroll College	200	---
1-4	---	Wolf Camp	---	---
1-5	---	Wolf Camp	---	---
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1-99	---	Wolf Camp	---	---
1-100	---	Wolf Camp	---	---

--Data is information not found, inventory is based on IIRAC records and field investigations.

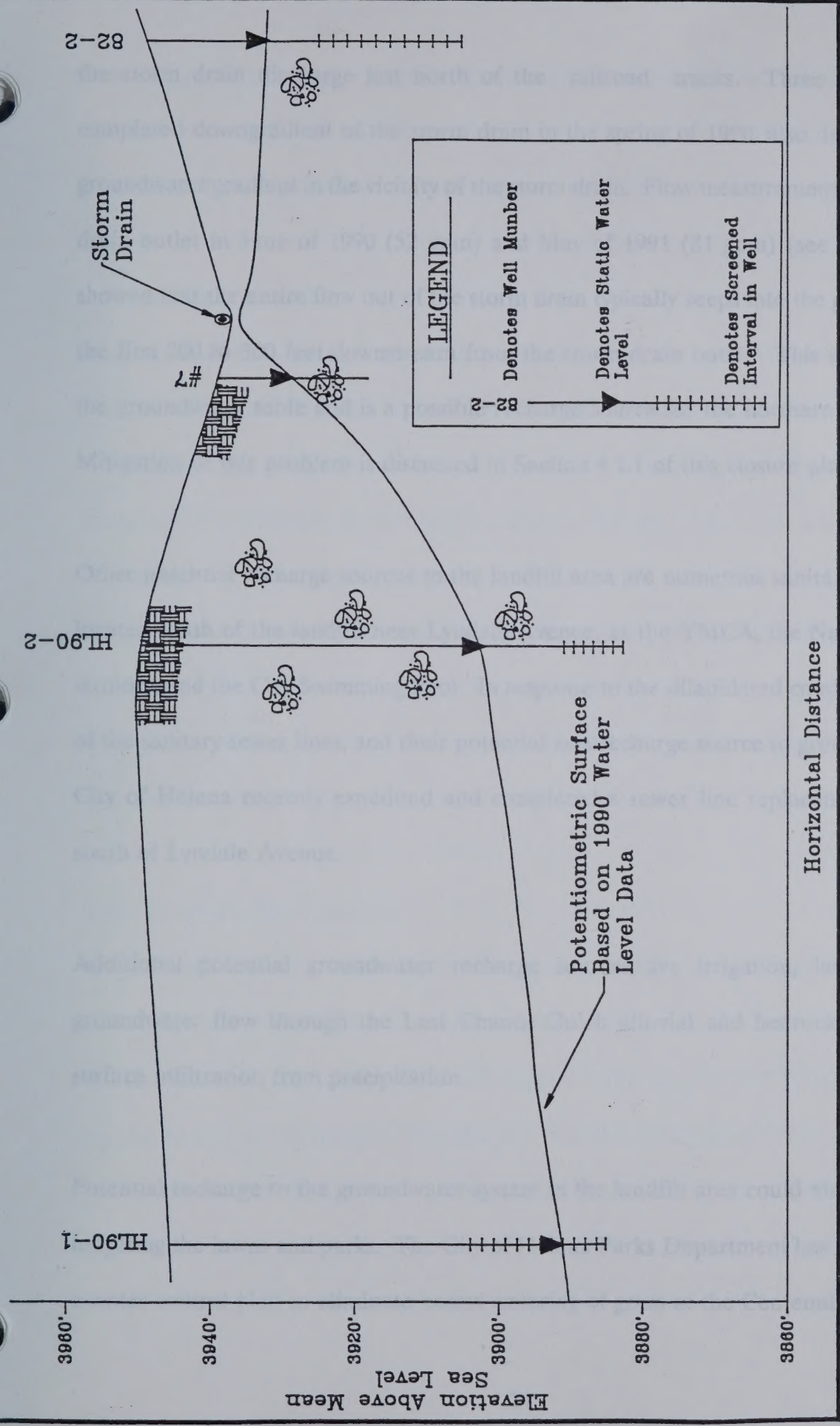


Figure 2.1: Hydrogeological Cross-Section Through Helena Landfill

Scale: Horizontal 1" = 300'
Vertical 1" = 20'

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the storm drain discharge just north of the railroad tracks. Three soil test pits, completed downgradient of the storm drain in the spring of 1990, also defined a steep groundwater gradient in the vicinity of the storm drain. Flow measurements at the storm drain outlet in June of 1990 (52 gpm) and May of 1991 (81 gpm) (see Appendix A) showed that the entire flow out of the storm drain typically seeps into the ground within the first 200 to 300 feet downstream from the storm drain outlet. This water mounds the groundwater table and is a possible recharge source for the northern landfill area. Mitigation of this problem is discussed in Section 4.1.1 of this closure plan.

Other potential recharge sources to the landfill area are numerous sanitary sewer lines located south of the landfill near Lyndale Avenue, at the YMCA, the National Guard Armory, and the City Swimming Pool. In response to the dilapidated condition of some of the sanitary sewer lines, and their potential as a recharge source to groundwater, the City of Helena recently expedited and completed a sewer line replacement program south of Lyndale Avenue.

2.3.1 Organic Water Quality

Additional potential groundwater recharge sources are irrigation, lawn watering, groundwater flow through the Last Chance Gulch alluvial and bedrock system, and surface infiltration from precipitation.

Potential recharge to the groundwater system in the landfill area could also occur from irrigating the lawns and parks. The City of Helena Parks Department has implemented a water control plan to eliminate excess watering of grass at the Centennial park. The

the storm drain discharge just north of the railroad tracks. These soil test pits completed investigation of the storm drain in the spring of 1990, also defined a steep groundwater gradient in the vicinity of the storm drain. Flow measurements at the storm drain outlet in June of 1990 (52 gpm) and May of 1991 (61 gpm) (see Appendix A) showed that the entire flow out of the storm drain typically enters into the ground within the first 500 to 700 feet downstream from the storm drain outlet. This water enters the groundwater table and is a possible recharge source for the northern landfill area. Mitigation of this problem is discussed in Section 4.1.5 of this cleanup plan.

Other potential recharge sources to the landfill area are numerous sanitary sewer lines located south of the landfill near Lyndale Avenue at the YMCA, the Veterans' Guard Armory, and the City Swimming Pool. In response to the identified conditions of some of the sanitary sewer lines and their potential as a recharge source to groundwater, the City of Houston recently completed and completed a sewer line replacement program south of Lyndale Avenue.

Additional potential groundwater recharge sources are irrigation lawn watering, groundwater flow through the East Channel Gulch effluent and backwash system, and surface infiltration from precipitation.

Potential recharge to the groundwater system in the landfill area could also occur from irrigation the lawn and garden. The City of Houston Parks Department has implemented a water control plan to eliminate excess watering of grass in the Community park. The

water balance control plan involves evaporation and transpiration estimates using the Jensen-Haise (1963) ET method, soil moisture monitoring, estimating moisture input from rainfall and irrigation, and water system malfunction checks.

2.3 WATER QUALITY

Many groundwater and surface water quality samples have been obtained in the vicinity of the Helena landfill over the past 13 years. These samples have been analyzed for both organic and inorganic parameters. Most historic data are for inorganic parameters since earlier regulations did not require organic analysis. Appendix A is a compilation of water quality data obtained from the Helena landfill area. The raw laboratory data are included in Appendix B. Additional water quality data are available in EPA's 1987 and 1989 reports. These data are not included because the EPA results showed obvious quality control problems and the results are not considered representative of actual groundwater conditions.

2.3.1 Organic Water Quality

In 1987 and 1989, EPA investigated the Helena landfill site and concluded that site problems were not sufficiently severe to place the site on the National Priority List (NPL). However, EPA analytical results suggested that low levels of organic compounds may be present in the vicinity of the landfill. Additional sampling by Hydrometrics, Inc., in the fall of 1989 and spring of 1990 and 1991 confirmed the presence of very low concentrations of volatile organic compounds (VOCs) beneath and peripheral to the landfill. Table 2.3 summarizes the types, chemical properties and uses of those VOCs

water balance control that involves evaporation and transpiration estimates using the Jensen-Haise (1963) ET method, soil moisture monitoring, estimating moisture input from rainfall and irrigation, and water system malfunction checks.

1.3. WATER QUALITY

Many groundwater and surface water quality samples have been obtained in the vicinity of the Halcrow landfill over the past 15 years. These samples have been analyzed for both organic and inorganic parameters. Most inorganic data are for hydrologic parameters since surface water quality did not require organic analysis. Appendix A is a compilation of water quality data obtained from the Halcrow landfill area. The raw laboratory data are included in Appendix B. Additional water quality data are available in EPA's 1987 and 1989 reports. These data are not included because the EPA results showed obvious quality control problems and the results are not considered representative of actual groundwater conditions.

1.3.1 Organic Water Quality

In 1987 and 1988, EPA investigated the Halcrow landfill site and concluded that the problems were not sufficiently severe to place the site on the National Priority List (NPL). However, EPA analytical results suggested that low levels of organic compounds may be present in the vicinity of the landfill. Additional sampling by Hydrochemical, Inc. in the fall of 1989 and spring of 1990 and spring of 1991 confirmed the presence of very low concentrations of volatile organic compounds (VOC) benzene and peripheral to the landfill. Table 1.3 summarizes the types, chemical properties and uses of these VOC

detected. The analytical methods used to measure the concentration of VOCs in the groundwater were EPA Method 502.2, EPA Method 624, and EPA Method 625 (regulated and unregulated VOCs) for semi-volatile organic compounds. A total of 53 VOC samples and 3 semi-volatile samples were obtained and analyzed from monitoring wells, domestic wells and irrigation wells during this investigation.

Results of groundwater sampling and testing (Appendix B) showed VOCs are present in several wells. Table 2.4 shows the EPA maximum contaminant levels (MCLs) for each compound in drinking water supplies.

The following summarizes the extent of organics in groundwater in the study area.

- 1) A total of 39 domestic, irrigation and monitoring wells northwest of the landfill area were sampled to determine water quality and 22 wells were surveyed to determine groundwater elevations. Based on this survey and a water level map, it has been determined that groundwater is generally flowing northwest from the landfill through sandy, silty, gravelly strata.
- 2) Groundwater samples obtained from several domestic wells (potable supplies) were analyzed for volatile organic compounds (VOCs). Results of these analyses show the levels of all VOCs are lower than levels established by the EPA as maximum contaminant levels (MCLs) for listed priority compounds. A listed priority compound is a compound that EPA

detected. The analytical methods used to measure the concentration of VOCs in the groundwater were EPA Method 8015, EPA Method 824, and EPA Method 825 (regulated and unregulated VOCs) for semi-volatile organic compounds. A total of 23 VOC samples and 2 semi-volatile samples were obtained and analyzed from monitoring wells, domestic wells and irrigation wells during this investigation.

Results of groundwater sampling and testing (Appendix B) showed VOCs are present in several wells. Table 1-4 shows the EPA maximum contaminant levels (MCLs) for each compound in drinking water supplies.

The following summarizes the extent of organic in groundwater in the study area.

1) A total of 39 domestic, irrigation and monitoring wells northwest of the landfill area were sampled to determine water quality and 22 wells were surveyed to determine groundwater elevations. Based on this survey and the water level map, it has been determined that groundwater is generally flowing northwest from the landfill through sandy, silty, gravelly areas.

2) Groundwater samples obtained from several domestic wells (private supplies) were analyzed for volatile organic compounds (VOCs). Results of these samples show the levels of all VOCs are lower than levels established by the EPA as maximum contaminant levels (MCLs) for listed priority compounds. A listed priority compound is a compound that EPA

TABLE 2.3 TYPICAL USES AND PROPERTIES OF THOSE ORGANIC COMPOUNDS DETECTED IN GROUNDWATER

- 1) 1,1 Dichloroethane, or ethylidene chloride (CH_3CHCl_2), is a mobile liquid that is colorless and sparingly soluble in water. Some common uses are an extraction solvent and a fumigant.
- 2) Tetrachloroethane, or perchloroethylene ($\text{Cl}_2\text{C}:\text{CCl}_2$), is a stable, colorless liquid that is nearly insoluble in water. Some common uses are for dry cleaning and as a degreasing solvent.
- 3) 1,1,1 Trichloroethane, or methyl chloroform (CH_3CCl_3), is a colorless liquid, nearly insoluble in water. Common uses are metal degreasing, an ingredient in pesticides, textile processing and as a solvent for cleaning precision instruments.
- 4) Trichloroethene, or (tri), ($\text{CH}:\text{CCl}_2$), is a stable, photoreactive liquid slightly soluble in water. It is used as a metal degreaser, a diluent in paints, a refrigerant and for dry cleaning.
- 5) Chloroform (CHCl_3) is colorless and heavily reactive with a characteristic odor. It is used in analytical chemistry, as a solvent, as an expansion agent in styrofoam and as a fumigant.
- 6) Dichloromonofluoromethane, or Freon 21, (CHCl_2F) is a colorless, nearly odorless, heavy gas. It is used as a refrigerant and as a solvent.
- 7,8) Cis or Trans 1, 2-Dichloroethene ($\text{ClHC}:\text{CHCl}_2$), is a colorless, low-boiling point liquid that exists in Cis and Trans isomers. It is slightly soluble in water and is used as a solvent, in lacquers, perfumes and thermoplastics.
- 9) 1,2 Dichloropropane, or propylene dichloride ($\text{CH}_3\text{CHClCH}_2\text{Cl}$), is a colorless stable liquid with a chloroform odor, nearly insoluble in water. It is used as a spotting agent, metal degreaser, soil fumigant for nematodes and a scouring compound.
- 10) Methylene chloride, or dichloromethane (CH_2Cl_2), is a colorless volatile liquid with an ether-like odor. It is slightly soluble in water and is used commonly for laboratory cleaning, a solvent for degreasing and a paint remover.
- 11) Dichlorodifluoromethane or fluorocarbon-12 (CCl_2F_2), is a colorless non-corrosive gas, nearly insoluble in water. Common uses are as an aerosol propellant and refrigerant.
- 12) Trichlorofluoromethane or fluorocarbon-11 (CCl_3F) is a colorless nearly odorless volatile liquid and is used as an aerosol propellant, solvent and in fire extinguishers.

Source: Sax and Lewis, 1987

TABLE 2. TYPICAL USES AND PROPERTIES OF THOSE ORGANIC COMPOUNDS DETECTED IN GROUNDWATER

1)	1,1-Dichloroethane, or ethylidene chloride (CH_2CHCl_2), is a colorless liquid that is colorless and slightly soluble in water. Some common uses are as an extraction solvent and a fumigant.
2)	Tetrachloroethane, or perchloroethylene (C_2Cl_4), is a stable, colorless liquid that is nearly insoluble in water. Some common uses are for dry cleaning and as a degreasing solvent.
3)	1,1,1-Trichloroethane, or methyl chloroform (CH_3CCl_3), is a colorless liquid, nearly insoluble in water. Common uses are metal degreasing, an ingredient in pesticides, textile processing and as a solvent for cleaning precision instruments.
4)	Trichloroethane, or (tri) (CHCl_3), is a stable, photoreactive liquid slightly soluble in water. It is used as a metal degreaser, a diluent in paints, a refrigerant and for dry cleaning.
5)	Chloroform (CHCl_3) is colorless and heavily reactive with a characteristic odor. It is used in analytical chemistry, as a solvent, as an expansion agent in equipment and as a fumigant.
6)	Dichloromethane, or Freon 21 (CH_2Cl_2), is a colorless, nearly odorless, heavy gas. It is used as a refrigerant and as a solvent.
7)	Cis or Trans 1,2-Dichloroethane (CH_2CHCl_2), is a colorless, low-boiling liquid that exists in Cis and Trans isomers. It is slightly soluble in water and is used as a solvent in lacquers, perfumes and thermoplastics.
8)	1,2-Dichloropropane, or propylene dichloride ($\text{CH}_3\text{CHClCH}_2\text{Cl}$), is a colorless, stable liquid with a chloroform odor, nearly insoluble in water. It is used as a peeling agent, metal degreaser, soil fumigant for nematodes and a secondary compound.
9)	Methylene chloride, or dichloromethane (CH_2Cl_2), is a colorless volatile liquid with an ether-like odor. It is slightly soluble in water and is used commonly for laboratory cleaning, a solvent for degreasing and a paint remover.
10)	Dichlorodifluoromethane, or fluorocarbon-12 (CCl_2F_2), is a colorless non-corrosive gas, nearly insoluble in water. Common uses are as an aerosol propellant and refrigerant.
11)	Trichlorofluoromethane, or fluorocarbon-11 (CCl_3F), is a colorless, nearly odorless, volatile liquid and is used as an aerosol propellant, solvent and in fire extinguishers.

Source: See and Lavelle 1987

TABLE 2.4 VOLATILE ORGANIC COMPOUND MAXIMUM
CONTAMINANT LEVELS HELENA LANDFILL

<u>Constituent</u>	<u>EPA Maximum Contaminant Level (MCL) Parts Per Billion (PPB)</u>	<u>Highest Concentration Found in any water well Parts per Billion (PPB)</u>
Dichlorodifluoromethane	Not Listed	6.6
Trichlorofluoromethane	Not Listed	<1.0*
1,1-Dichloroethene	7.0	<.50*
Methylene Chloride	5.0 (proposed)	1.1
1,1-Dichloroethane	Not Listed	1.5
Cis-1,2-Dichloroethene	70.0	2.0
Chloroform, Dibromomethane, Bromodichloromethane, Bromomethane	100.0 (for the sum of all)	11.0
1,1,1-Trichloroethane	200.0	1.9
Tetrachloroethane	5.0	8.1
Trichloroethene	5.0	1.8

*Present but less than the method detection limit.

TABLE 1. VOLATILE ORGANIC COMPOUND MAXIMUM
CONTAMINANT LEVELS HELENA LANDFILL

Compound	EPA Maximum Concentration Level (MCL) Parts per Billion (PPB)	Highest Concentration Found in any water well Parts per Billion (PPB)
Acetone	Not Listed	0.2
Chloroform	Not Listed	<1.0*
1,1-Dichloroethane	7.0	<1.0*
Methylene Chloride	2.0 (proposed)	1.1
1,2-Dichloroethane	Not Listed	1.2
Chloroform	7.0	1.0
Chloroform, Dinitrochlorobenzene, Dinitrofluorobenzene, Dinitrophenol, Dinitrotoluene	10.0 (for the sum of all)	7.0
1,1,1-Trichloroethane	20.0	9
Tetrachloroethane	2.0	2.1
Trichloroethene	2.0	1.8

*Present but less than the method detection limit

has identified because of its potential toxicological effects, and has set a maximum concentration which cannot be exceeded for drinking water.

- 3) Several VOCs were detected in irrigation wells northwest of the landfill. The concentrations of these compounds are very low (less than 10 parts per billion). With the exception of tetrachloroethane, no VOC concentration was above the EPA MCL for the irrigation wells tested. Tetrachloroethane was detected in wells upgradient of the landfill as well as wells downgradient of the landfill. This indicates the landfill is likely not the only source of the tetrachloroethane. The maximum concentration of tetrachloroethane detected in any irrigation well was 8.1 parts per billion, which is 3.1 parts per billion above the MCL. The EPA criteria for determining the MCL for VOCs is based on consumption of two liters of water per day. Tetrachloroethane concentrations exceeded the EPA MCL in four irrigation wells. No potable water supply well tested showed tetrachloroethane levels above the EPA MCL.

- 4) Three VOCs, not listed by the EPA as priority compounds (Table 2.4), were detected in various wells. Because EPA does not consider these priority compounds, there has been no EPA maximum contaminant level established for these compounds. However, EPA has set maximum concentration limits for various known and suspected toxic and

has identified because of its potential technological effects and has set a maximum concentration which cannot be exceeded for drinking water.

2)

Several VOCs were detected in irrigation wells northwest of the landfill. The concentrations of these compounds are very low (less than 10 parts per billion). With the exception of tetrachloroethane, no VOC concentration was above the EPA MCL for the irrigation wells tested. Tetrachloroethane was detected in wells upstream of the landfill as well as wells downstream of the landfill. This indicates the landfill is likely not the only source of the tetrachloroethane. The maximum concentration of tetrachloroethane detected in any irrigation well was 8.1 parts per billion which is 3.3 parts per billion above the MCL. The EPA criteria for determining the MCL for VOCs is based on consumption of two liters of water per day. Tetrachloroethane concentrations exceeded the EPA MCL in four irrigation wells. Two private water supply wells tested showed tetrachloroethane levels above the EPA MCL.

4)

Three VOCs not listed by the EPA as priority compounds (Table 2A) were detected in various wells. Because EPA does not consider these priority compounds, there has been no EPA maximum contaminant level established for these compounds. However, EPA has set maximum concentration limits for various known and suspected toxic and

carcinogenic compounds at a level higher than the concentrations of these non-priority compounds detected near the landfill. It is anticipated that when EPA limits are established for these non-priority compounds, these limits will be higher than the concentrations of the compounds present in the tested wells.

- 5) All other testing of water from irrigation and potable water supply wells show levels of organic and inorganic constituents are lower than the EPA MCLs.

Exhibit 2, shows the approximate lateral extent of selected organic compounds in the groundwater based on 1991 sampling events. Dichlorodifluoromethane was selected as the parameter to be plotted because of its relatively low retardation factor and because it is a common landfill contaminate. Dichlorodifluoromethane is a fluorocarbon used most extensively as an aerosol propellant for hair sprays, deodorants and many other household products. In addition, it is used as a refrigerant. The retardation coefficient for dichlorodifluoromethane in this alluvial system is approximately 1.6, or, groundwater can be expected to move 1.6 feet for every 1 foot dichlorodifluoromethane moves in the groundwater system. This difference in travel rates between groundwater and VOCs such as dichlorodifluoromethane is due to their affinity for soil particles (especially organic soil), and therefore the VOCs move at velocities less than the groundwater. Calculations for the retardation coefficient of dichlorodifluoromethane are shown in Table 2.5.

carcinogenic compounds at a level higher than the concentration of these non-priority compounds detected near the landfill. It is anticipated that when EPA limits are established for these non-priority compounds, these limits will be higher than the concentrations of the compounds present in the tested wells.

All other testing of water from irrigation and domestic water supply wells shows levels of organic and inorganic constituents are lower than the EPA MCL.

Figure 1 shows the approximate relative extent of selected organic compounds in the groundwater based on 1991 sampling events. Dichlorodibenzomethane was selected as the parameter to be plotted because of its relatively low retardation factor and because it is a common poorly volatile compound. Dichlorodibenzomethane is a benzene ring with two chlorine atoms at the 1 and 4 positions. It is a relatively non-polar compound and is not readily degraded by bacteria and many other microbial products. In addition, it is used as a reference compound for the chlorinated compounds in this study. The retardation coefficient for dichlorodibenzomethane in this study is approximately 1.6 on groundwater can be expected to move 1.6 feet for every 1 foot dichlorodibenzomethane moves in the groundwater system. The difference in travel times between groundwater and VOCs such as dichlorodibenzomethane is due to their affinity for soil particles (especially organic soil), and therefore the VOCs move at velocities less than the groundwater. Calculations for the retardation coefficient of dichlorodibenzomethane are shown in

In addition to retardation, other attenuation mechanisms decrease the concentration of organic compounds as they move through the groundwater away from the source of contamination. These mechanisms are dispersion or lateral spreading of the compound, and degradation (both chemical and by micro-organisms). It is difficult to determine exactly how much effect each of these attenuation mechanisms has on a solute because many factors such as solute concentration, aquifer characteristics, and geochemical factors are involved.

A sanitary landfill has a relatively simple mechanism of leachate production. In general, water percolates into, or is initially present in landfill refuse and creates a solute or a leachate. Residual water and chemicals present during landfilling could include partially filled containers of paint, lacquer, cleaning fluids, aerosols, plastics, organic products and free liquid chemicals. Containers either break and release the chemicals immediately, or slowly rust and release the chemicals over time. Additional landfilled chemicals could include pesticides, fumigants, fuels, oils and many others (Sax and Lewis, 1987).

Some of the chemical compounds commonly found in landfill leachate are dichlorodifluoromethane, trichlorofluoromethane, trichloroethane, 1-2-dichloroethene, methylene chloride and tetrachloroethane. Dichlorodifluoromethane and trichlorofluoromethane were commonly used as aerosol propellants (Table 2.3). 1-2-Dichloroethene (both in cis and trans isomers) is commonly used as a household lacquer and trichloroethene is commonly used to dilute paint. Methylene chloride is commonly

In addition to retardation, other attenuation mechanisms decrease the concentration of organic compounds as they move through the groundwater away from the source of contamination. These mechanisms are dispersion or lateral spreading of the compound, and degradation (both chemical and by micro-organisms). It is difficult to determine exactly how much effect each of these attenuation mechanisms has on a solute because many factors such as solute concentration, aquifer characteristics, and geochemical

factors are involved.

A secondary landfill has a relatively simple mechanism of leachate production. In general, waste materials enter or are initially present in landfill cells and create a solute or a leachate. Leachate water and chemical present during landfilling could include partially filled components of paint, ink, paper, cleaning fluids, aerosols, plastic, organic products and free liquid chemicals. Components either break and release the chemicals immediately or slowly and release the chemicals over time. Additional landfilled materials could include petroleum, hydraulic oils and many others (Fox and Leach,

Some of the chemical compounds commonly found in landfill leachate are dichloromethane, trichloromethane, trichloroethylene, 1,2-dichloroethane, methyl ethyl ketone and tetrahydrofuran. Dichloromethane and trichloromethane were commonly used as aerosol propellants (Table 2.2). 1,2-dichloroethane (and its isomer 1,1-dichloroethane) is commonly used as a household insecticide and trichloroethane is commonly used in blue paint. Methyl ethyl ketone is commonly

TABLE 2.5 RETARDATION OF DICHLORODIFLUOROMETHANE

Aquifer Characteristics

% Organic Carbon	=	0.06 Calculated
% SOM	=	0.10
Bulk density	=	1.72 Calculated
Porosity	=	0.35

Chemical Compound

Dichlorodifluoromethane

Solubility equation used was $\log K_{oc} = 3.64 + .55 * -\log 280$ Solubility = $0.28E + 03$ mg/l

Log Solubility = 2.45

(Solubility was entered into program as 280 mg/l)

Koc = $0.20E + 03$

Log Koc = 2.29

Retardation Coefficient = 1.6

Rf value = 0.6403

Solubility equivalents based on molecular weight of 120.92

<u>mg/l</u>	<u>micromoles/l</u>	<u>mole fraction</u>
-------------	---------------------	----------------------

0.2800E + 03	0.2316E + 04	0.4171E -04
--------------	--------------	-------------

Logs of above solubilities

2.4472	3.3647	-4.3797
--------	--------	---------

Source: Oklahoma State University, Dr. Hanslow, 1988.

used as a paint remover. Tetrachloroethane is used in dry cleaning and as a degreasing solvent. The production of tetrachloroethane alone exceeded 300 thousand tons per year in the United States in 1982 (Moore and Ramamoorthy, 1984).

In addition to landfill leachate generation, additional sources of organic compounds present in the groundwater in the vicinity of the landfill are likely. Irrigation wells near the landfill were sampled and showed low levels of tetrachloroethane and chloroform. These include wells 28, 34 and 24 (see Exhibit 1). A source of organic contaminants upgradient of these wells is likely adding to the low levels of organic compounds in the groundwater. The source of these compounds is unknown however, dry cleaners, service stations or other industrial facilities in the Euclid Avenue area could be the potential source of the low levels of tetrachloroethane. Chloroform (and the low levels of other trihalomethanes) in the groundwater could be partially the result of lawn watering with City of Helena water or leaky sanitary sewer lines. Analysis showed concentrations of trihalomethanes in three city water samples below the EPA MCL, but were in the 90 parts per billion range, which is well above any concentrations found in the groundwater.

In addition to trihalomethanes in city water, chlorinated water discharged in sanitary sewers from the YMCA and city pool could seep into the groundwater and create chloroform. Humic and fulvic acids (commonly present in organic soils) have the required structural and functional arrangements for a haloform reaction (Moore and Ramamoorthy, 1984). Sanitary sewer pipes from the city pool are designated by the City

used as a paint remover. Tetrachloroethane is used in dry cleaning and as a degreasing solvent. The production of tetrachloroethane alone exceeded 500 thousand tons per year in the United States in 1983 (Moore and Ramamoorthy, 1984).

In addition to landfill leachate generation, additional sources of organic compounds present in the groundwater in the vicinity of the landfill are likely. Irrigation wells near the landfill were sampled and showed low levels of tetrachloroethane and chloroform. These include wells 28, 34 and 36 (see Exhibit 1). A source of organic compounds in the operation of these wells is likely adding to the low levels of organic compounds in the groundwater. The source of these compounds is unknown; however, dry cleaners, service stations or other industrial facilities in the Euclid Avenue area could be the potential source of the low levels of tetrachloroethane, chloroform (and the low levels of other trichloroethanes) in the groundwater could be partially the result of leachate mixing with City of Helena water or leaky sanitary sewer lines. Analysis showed concentrations of trichloroethanes in three city water samples below the EPA MCL, but were in the 90 parts per billion range, which is well above any concentrations found in the groundwater.

In addition to trichloroethanes in city water, chlorinated water discharged in sanitary sewers from the YMCA and city pool could seep into the groundwater and create chloroform. Humic and fulvic acids (commonly present in organic soils) have the potential to react with chlorinated water to form trichloroethanes (Moore and Ramamoorthy, 1984). Sanitary sewer pipes from the city pool are designed by the City

as class 2 pipelines. The classification system ranges from Class 1, sewage pipes that are heavily dilapidated, to class 5, sewage pipes that have been recently replaced.

As discussed in Section 2.2, the city storm drain is likely creating a groundwater mound in the landfill area. A portion of this groundwater could be percolating through refuse, and it also may initially contain organic compounds from the storm drainage area which is Last Chance Gulch. Samples of this storm drain water obtained previously by EPA showed low levels of VOCs.

Generally, storm drainage is poor in quality because it contains street runoff which significantly degrades water. In addition, there could possibly be illegal discharges into city drains. Sanitary sewer pipes upgradient of monitoring well HL-1 are in poor condition and are designated by the City as class 1 pipes. These pipes were installed in the late 1800s and are dilapidated. A water sample obtained from monitoring well HL-1 and analyzed for coliform bacteria (a bacteria present in the feces of warm blooded animals) showed significant contamination. Because of this problem, these dilapidated pipes were placed on an expedited replacement plan by the City.

2.3.2 Inorganic Water Quality

Inorganic water quality beneath and peripheral to the Helena landfill (Appendix B) also indicates a plume is present. Chloride concentrations and specific conductivity are elevated in the landfill vicinity and decrease in concentration downgradient of the landfill. The total dissolved solids concentration in groundwater in the landfill vicinity

sewer 1 pipelines. The classification system ranges from Class 1, sewage pipes that are heavily discolored to Class 2, sewage pipes that have been recently replaced.

As discussed in Section 2.2, the city storm drain is likely creating a groundwater mound in the landfill area. A portion of this groundwater could be percolating through refuse, and it also may contain organic compounds from the storm drainage area which is land disposal. Samples of this storm drain water obtained previously by EPA showed the level of VOCs.

Generally, storm drain water is poor in quality because it contains street runoff which significantly degrades water. In addition, there could possibly be illegal discharges into city drains. Storm sewer pipe inspection of monitoring well HL-1 are in poor condition and are designed to the CIP as class 1 pipe. These pipes were installed in the late 1970s and are discolored. A water sample obtained from monitoring well HL-1 and analyzed for coliform bacteria (a bacteria present in the feces of warm blooded animals) showed significant contamination. Because of this problem, these discolored pipes were placed on an expedited replacement plan by the City.

2.3.3. Groundwater Quality

Groundwater quality located and reported to the Nelson landfill (Appendix B) also indicates a plume is present. Chloride concentrations and specific conductivity are elevated in the landfill vicinity and decrease in concentration downgradient of the landfill. The total dissolved solids concentration in groundwater in the landfill vicinity

(Appendix B) is slightly higher than the secondary drinking water standard of 500 mg/l. Nitrate plus nitrite is present in groundwater in several wells and has historically exceeded 10 mg/l in monitoring wells completed in the landfill (Appendix B). Concentrations of other major minerals appear to be elevated in the vicinity of the landfill. These excavated levels are likely due to the landfill as well as other upgradient sources. Concentrations of dissolved metals in the groundwater show no apparent water quality change in the vicinity of or downgradient of the landfill.

3.1 SOURCES AND PHYSICAL CHARACTERISTICS OF THE COVER SOIL

Two major soil sources are being utilized in the first cover by the City of Helena Landfill. These two sources are the landfill site itself and the City of Helena Remedial Basin area located north of K-Mart along Interstate 90. These two sources will be discussed in detail, individually in the following sections.

3.1.1 Helena Landfill Area Soil

The eastern portion of the landfill (landfill cells 1 through 10) was first covered and capped in 1967. The cover soil used to cover this portion of the landfill was soil that was stockpiled during the excavation of landfill cells. A 1992 Comprehensive Remedial Soils Evaluation of the City of Helena Landfill Area was conducted on the site and soils are found falling within the GM, ML, and SM categories of the Unified Soil Classification System. The Administrative Rules of Montana require that all soils placed on and types are typically having permeabilities ranging from 10^{-4} to 10^{-6} cm/sec. Double ring infiltrometers installed on these in-place cover soils always provide values of the

(Appendix B) is slightly higher than the secondary drinking water standard of 500 mg/l. Nitrate plus nitrite is present in groundwater in several wells and has historically exceeded 10 mg/l in monitoring wells completed in the landfill (Appendix B). Concentrations of other major minerals appear to be elevated in the vicinity of the landfill. These elevated levels are likely due to the landfill as well as other upgradient sources. Concentrations of dissolved metals in the groundwater show no apparent water quality change in the vicinity of or downgradient of the landfill.

3.0 COVER SOIL

The type of soil used for covering landfill refuse is very important in controlling landfill leachate. The cover soil used for the City of Helena Landfill closure meets all requirements set forth by the State of Montana (ARM Title 16, Chapter 14, Subchapter 5, Section 16.14.521 (2), and the MDHES document of April 3, 1991, entitled "Class II Landfill Closure Requirements and Recommendations".

3.1 SOURCES AND PHYSICAL CHARACTERISTICS OF THE COVER SOIL

Two cover soil sources are being utilized in the final cover for the City of Helena Landfill. These two sources are the landfill site itself, and the City of Helena Retention Basin area located north of K-Mart along Interstate 15. These two sources will be discussed in detail, individually in the following sections.

3.1.1 Helena Landfill Area Soil

The eastern portion of the landfill (landfill cells 2 through 16) have been covered and reseeded since 1987. The cover soil used to cover this portion is landfill area soil that was stockpiled during the excavation of landfill cells. A 1982, Hydrometrics report entitled "Soils Evaluation of the City of Helena Landfill Area" identified the landfill area soils as loams falling within the GM, ML and SM categories of the Unified Soil Classification System. The Administrative Rules of Montana (ARM 16.14.505) defines these soil types as typically having permeabilities ranging from 10^{-6} to 10^{-3} cm/sec. Double ring infiltrometer tests on these in-place cover soil showed permeabilities of the

3.0 COVER SOIL

The type of soil used for covering landfill refuse is very important in controlling landfill leachate. The cover soil used for the City of Helena Landfill consists of all requirements set forth by the State of Montana (ARM Title 16, Chapter 14, Subchapter 2, Section 16-14-321 (2)) and the MCHES document of April 3, 1991, entitled "Class II Landfill Closure Requirements and Recommendations".

3.1 SOURCES AND PHYSICAL CHARACTERISTICS OF THE COVER SOIL

Two cover soil sources are being utilized in the final cover for the City of Helena Landfill. These two sources are the landfill site itself and the City of Helena Retention Basin Area located north of K-Mart along Interstate 15. These two sources will be discussed in detail individually in the following sections.

3.1.1 Helena Landfill Area Soil

The eastern portion of the landfill (landfill cells 2 through 16) have been covered and reseeded since 1987. The cover soil used to cover this portion is landfill area soil that was stockpiled during the construction of landfill cells. A 1982 Hydrometrics report entitled "Soils Evaluation of the City of Helena Landfill Area" identified the landfill area soils as having falling within the GM, ML and SM categories of the Unified Soil Classification System. The Administrative Rules of Montana (ARM 16-14-302) defines these soil types as typically having permeabilities ranging from 10^{-6} to 10^{-8} cm/sec. Double ring infiltration tests on these in-place cover soil showed permeabilities of the

cover ranging from 4.4×10^{-4} to 3.6×10^{-5} cm/sec. All values were well below the 1×10^{-3} cm/sec requirement set forth by the MDHES. Figure 3.1 shows the locations of the double ring infiltration tests. The double ring infiltrometer tests are included in Appendix C.

Soil samples collected from the landfill site in 1990 and 1991 have been analyzed in a laboratory for particle size distribution and permeability. The sample locations are shown on Figure 3.1 and lab results are included in Appendix C. The particle size analyses showed that the soils are sandy, gravelly loam with a large clay and silt fraction. The clay and silt fraction for the samples ranged from 17 to 31 percent. This large percentage of fine materials controls the hydraulic properties of the soil resulting in relatively low permeabilities. A laboratory permeability test performed on a sample taken from the landfill site in 1989 showed a permeability of 5.8×10^{-6} cm/sec for the soil (Appendix C).

3.1.2 City of Helena Retention Basin Area Soils

The western portion of the landfill, cells 1 and 17 through 20, will be covered with soils borrowed from the City of Helena Retention Pond Basin excavations located north of K-Mart along Interstate 15. The majority of the soil in this area is a gravelly loam similar to that at the landfill site. A red clay-rich sand with very few gravels is also present interbedded with the gravelly loam.

cover ranging from 4.4×10^{-6} to 3.6×10^{-5} cm/sec. All values were well below the 1×10^{-5} cm/sec requirement set forth by the MCHES. Figure 3.1 shows the locations of the double ring infiltration tests. The double ring infiltration tests are included in Appendix C.

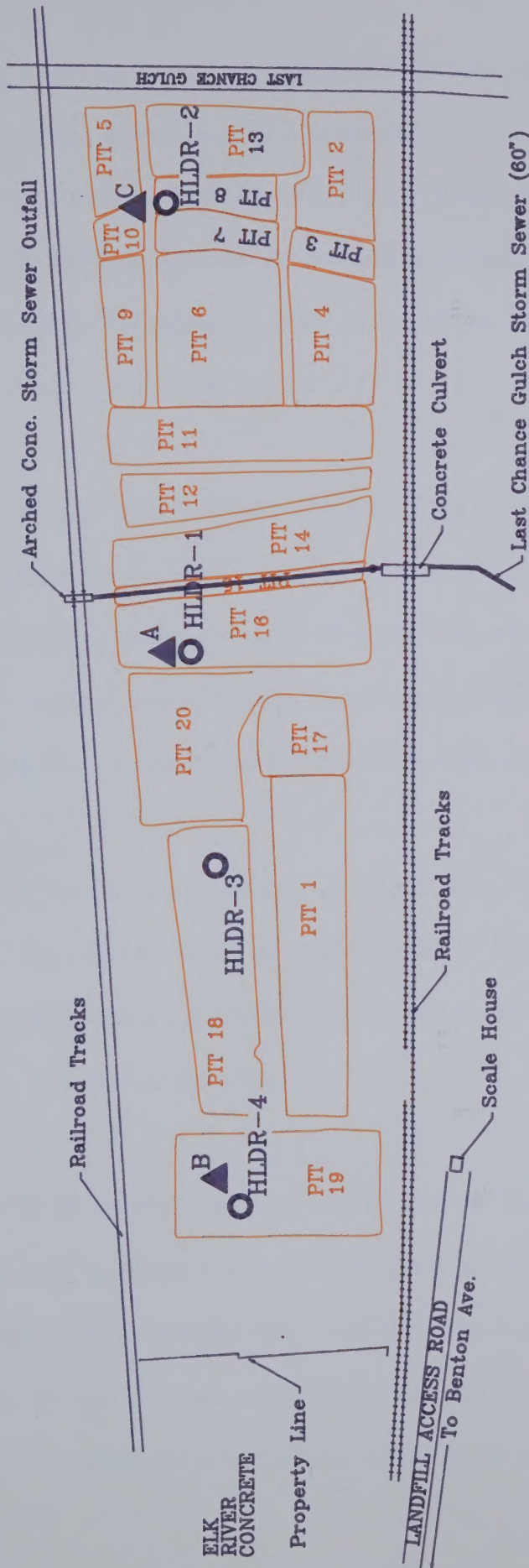
Soil samples collected from the landfill site in 1990 and 1991 have been analyzed in a laboratory for particle size distribution and permeability. The sample locations are shown on Figure 3.1 and lab results are included in Appendix C. The particle size analyses showed that the soils are sandy, gravelly loam with a large clay and silt fraction. The clay and silt fraction for the samples ranged from 17 to 31 percent. This large percentage of fine materials controls the hydraulic properties of the soil resulting in relatively low permeability. A laboratory permeability test performed on a sample taken from the landfill site in 1989 showed a permeability of 2.8×10^{-6} cm/sec for the soil (Appendix C).

3.3.1 City of Helena Retention Basin Area Soils

The western portion of the landfill cells 1 and 17 through 20 will be covered with soils borrowed from the City of Helena Retention Pond Basin excavations located north of Helena along Interstate 15. The majority of the soil in this area is a gravelly loam similar to that at the landfill site. A red clay-rich sand with very few gravels is also present interbedded with the gravelly loam.



NORTH



SCALE
1 inch = 300 feet

LEGEND

-  Outline and Number of Landfill Pit
-  Soil Sample Location and Identification
-  Double Ring Infiltration Test Location and Number

Figure 3.1: Location of Double Ring Infiltration Tests and Soil Samples

Double ring infiltrometer tests were performed on both of these soils. The gravelly loam soil (RPDR-2) was shown to have a permeability of 3×10^{-4} cm/sec, while the clayey sand (RPDR-1) had a permeability of 8.1×10^{-5} cm/sec (Appendix C). These tests show that both soils would be suitable for use as a cover soil, however the City is separating the two soils and stockpiling as much of the clayey sand as possible for use in the uppermost portion of the final cover.

3.2 COVER SOIL REQUIREMENTS AND QUALITY CONTROL

Montana Administrative Rule ARM 16.14.521 and the MDHES document of April 3, 1991 require that at least two feet of cover soil with a permeability of less than 1×10^{-3} cm/sec be applied over all areas which have received landfill materials. These requirements will be ensured by the following methods.

The City has performed a number of infiltrometer tests for internal quality control measures. The results of these tests are included in Appendix C. All infiltrometer tests performed on the cover soils have shown the soil to meet the permeability requirements set forth by the State of Montana.

The depth of all in-place cover soil will be verified by physical inspection of site area using excavating equipment after the final cover soil has been placed. The excavations will be spaced 100 to 200 feet apart and will be at least two feet deep or to the cover soil/refuse contact. If cover soils of less than two feet are found, these areas will be delineated and additional cover will be added to meet the two foot requirement.

Double ring infiltrometer tests were performed on both of these soils. The gravelly loam soil (RTPDR-2) was shown to have a permeability of 3×10^{-4} cm/sec, while the clayey sand (RTPDR-1) had a permeability of 8.1×10^{-5} cm/sec (Appendix C). These tests show that both soils would be suitable for use as a cover soil, however the City is separating the two soils and stockpiling as much of the clayey sand as possible for use in the uppermost portion of the final cover.

3.2 COVER SOIL REQUIREMENTS AND QUALITY CONTROL

Montana Administrative Rule ARM 16.14.321 and the MDHES document of April 3, 1991 require that at least two feet of cover soil with a permeability of less than 1×10^{-4} cm/sec be applied over all areas which have received landfill materials. These requirements will be ensured by the following methods.

The City has performed a number of infiltrometer tests for internal quality control measures. The results of these tests are included in Appendix C. All infiltrometer tests performed on the cover soils have shown the soil to meet the permeability requirements set forth by the State of Montana.

The depth of all in-place cover soil will be verified by physical inspection of site areas using excavating equipment after the final cover soil has been placed. The excavations will be spaced 100 to 200 feet apart and will be at least two feet deep in the cover soil/rock contact. If cover soils of less than two feet are found, these areas will be delineated and additional cover will be added to meet the two foot requirement.

4.0 FINAL COVER DESIGN

The final cover for the City of Helena Landfill has been designed as per the State of Montana Class II Landfill Closure Requirements and Recommendations (April 3, 1991). Proposed future land use, maintenance and monitoring have all been considered in the final cover design.

4.1 DRAINAGE - RUNON/RUNOFF PLAN

Exhibit 3 shows the final grading and drainage plan for the completed cover on the Helena Landfill. This plan allows precipitation to runoff quickly and efficiently away from all areas which contain buried refuse. The cover topography of the landfill, and the drainage ditch system peripheral to the landfill were designed to eliminate surface runoff. Runoff from the Last Chance Gulch area, however, drains under the landfill in the city storm drain running below the landfill. To eliminate potential recharge due to the landfill from this source, the drain will be extended to discharge further away from the landfilled areas. This extension is detailed in Section 4.1.1 of this closure plan.

This drainage plan incorporates the drainage plan designed by Damschen and Associates for the proposed transfer station to be located at the present landfill site. This is contingent on the permitting process for the transfer facility and the proposed new Lewis and Clark County Landfill located northeast of Helena.

4.0 FINAL COVER DESIGN

The final cover for the City of Helena Landfill has been designed as per the State of Montana Class II Landfill Closure Requirements and Recommendations (April 3, 1991). Proposed future land use, maintenance and monitoring have all been considered in the final cover design.

4.1 DRAINAGE - RUNOFF/RUNOFF PLAN

Exhibit 3 shows the final grading and drainage plan for the completed cover on the Helena Landfill. This plan allows precipitation to runoff quickly and efficiently away from all areas which contain buried refuse. The cover topography of the landfill, and the drainage ditch system peripheral to the landfill were designed to eliminate surface runoff. Runoff from the East Chance Gulch area, however, drains under the landfill in the city storm drain running below the landfill. To eliminate potential seepage due to the landfill from this source, the drain will be extended to discharge further away from the landfill area. This extension is detailed in Section 4.1.1 of this closure plan.

This drainage plan incorporates the drainage plan designed by Darnsden and Associates for the proposed transfer station to be located at the present landfill site. This is contingent on the permitting process for the transfer facility and the proposed new East Helena and Clark County Landfills located northeast of Helena.

4.1.1 Extension of the City Storm Drain

Springtime flows for the Last Chance Gulch area storm drain outfall located just north of the landfill were measured in 1990 and 1991. These flow measurements are shown in Appendix A. Flows from the outfall ranged from 52 gallons per minute (gpm) to 81 gpm and all flow typically percolates into the ground within the first 200 feet of the channel below the outfall. This channel is excavated to the north of the landfill along the east side of Bill Roberts Golf Course. The water which seeps into the ground causes a mounding effect on the local water table that could potentially saturate refuse or recharge the aquifer with poor quality storm runoff water.

Figure 4.1 is a cross-section which shows the mounded water table (under high water table conditions) and its relationship to the landfill cell area. This cross-section suggests that the northwest corner of the landfill cell number 18 has the highest potential to be impacted by the mounded water table. It is important to note that several assumptions have been made in the preparation of this cross-section. These assumptions are outlined as follows:

1. That the outfall from the storm drain is essentially a point recharge to the groundwater system. This requires that the storm drain running beneath the landfill is competent and that no leakage occurs. The storm drain was inspected by city workers in 1990 (personal communication, Dick Nisbet, May 1991) and no leakage was observed in the concrete section above the location of the outfall near the northern most railroad track (Exhibit 1).

Springer flow for the Last Chance Gulch area storm drain outfall located just north of the landfill were measured in 1990 and 1991. These flow measurements are shown in Appendix A. Flow from the outfall ranged from 55 gallons per minute (gpm) to 81 gpm and all flow typically percolates into the ground within the first 200 feet of the channel below the outfall. The channel is excavated to the north of the landfill along the east side of Bill Roberts Golf Course. The water which seeps into the ground causes a mounding effect on the local water table that could potentially saturate refuse or leachate the refuse with poor quality storm runoff water.

Figure 4.1 is a cross-section which shows the mounded water table (under high water table conditions) and its relationship to the landfill cell area. This cross-section suggests that the northwest corner of the landfill cell number 18 has the highest potential to be impacted by the mounded water table. It is important to note that several assumptions have been made in the preparation of this cross-section. These assumptions are outlined as follows:

1. That the outfall from the storm drain is essentially a point recharge to the groundwater system. This requires that the storm drain running beneath the landfill is impervious and that no leakage occurs. The storm drain was inspected by city workers in 1990 (personal communication, Dick Nisbet, May 1991) and no leakage was observed in the concrete section above the location of the outfall near the northern most railroad track (Exhibit 1).

ELEVATION
(above M.S.L.)

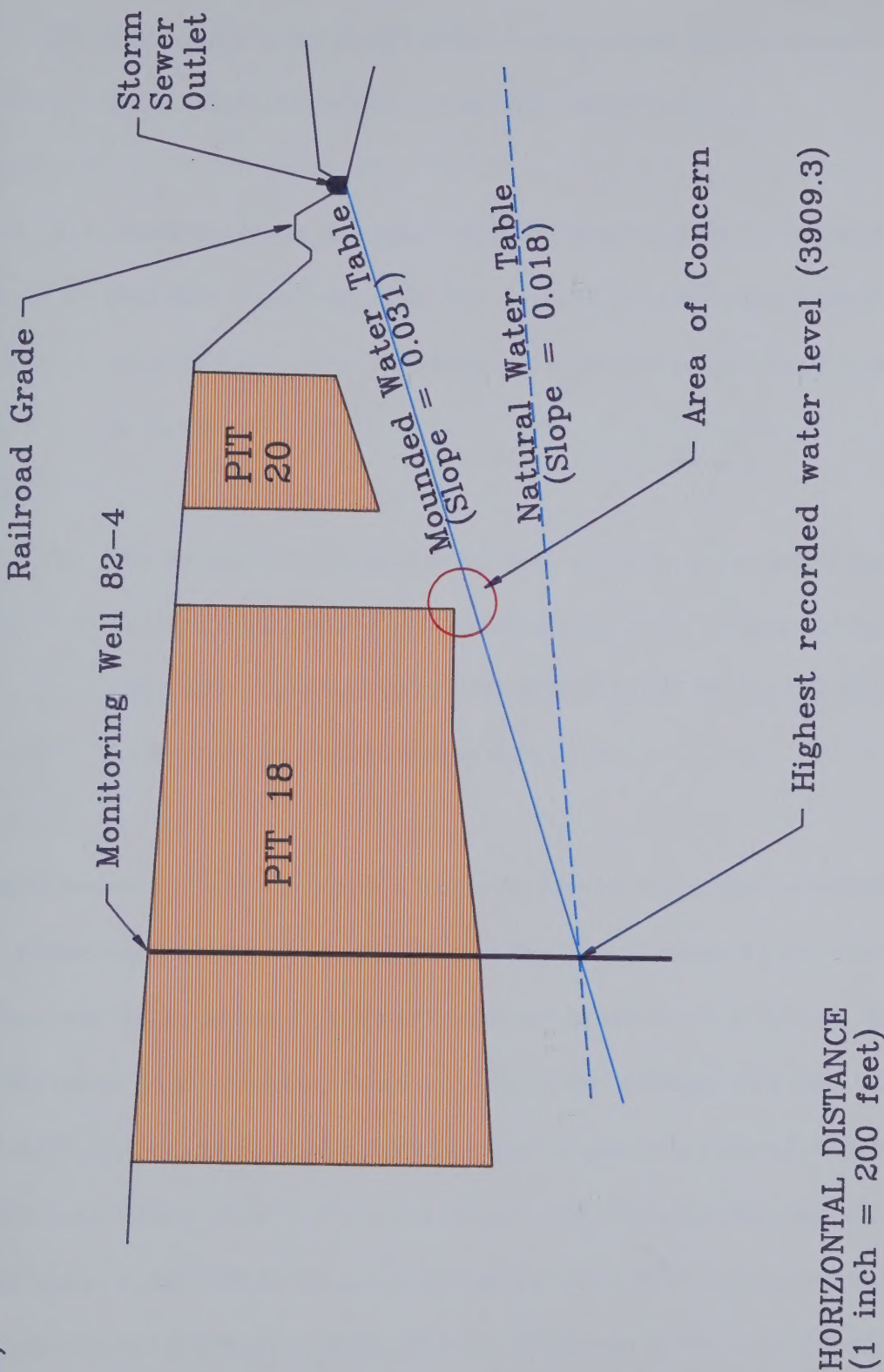
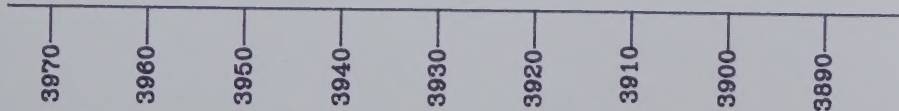


Figure 4.1: Cross-Section of
Storm Sewer Outfall Area

2. The aquifer in the outfall area is homogeneous and the mounding the water table is uniform radially around the outfall "point".

3. The slope of the mounded water table between the outfall and monitoring well 82-4 is uniform. This is a conservative assumption because the water table is likely parabolic in shape and would not actually have as much impact as assumed.

4. The natural (unmounded) water table gradient in the outfall area would be similar to that north of the landfill outside of the influence of the mounding. Materials in monitoring well HL-90-1 north of the landfill were similar to those in HL-90-2 located near the outfall.

The cross-section shown in Figure 4.1 uses the highest water table condition on record for monitoring well 82-4. The water level at that time of measurement, with mounding effects, was within several feet of the bottom of the refuse. It is possible that capillary action could have caused moisture to contact the garbage. To help alleviate this potential problem, the City of Helena proposes to move the point of recharge from the storm drain downgradient to a location where it will have a minimal impact on the water table under the landfill. This would be accomplished by lining the storm drain outfall for approximately 600 feet before the water discharges to the natural unlined channel where percolation can occur. The design of the channel is discussed in the following section.

where percolation can occur. The design of the channel is discussed in the following for approximately 500 feet before the water discharges to the natural unfilled channel table under the landfill. This would be accomplished by lining the storm drain outfall storm drain downstream to a location where it will have a minimal impact on the water potential problem, the City of Helena proposes to move the point of recharge from the action could have caused moisture to contact the garbage. To help alleviate this effect, was within several feet of the bottom of the refuse. It is possible that capillary for monitoring well 83-4. The water level at that time of measurement, with mounding The cross section shown in Figure 4.1 uses the highest water table condition on record

those in HI-96-2 located near the landfill.

Monitors in monitoring well HI-90-1 north of the landfill were similar to similar to that north of the landfill outside of the influence of the mounding. The natural (unmounded) water table gradient in the outfall area would be

as assumed

table is likely parabolic in shape and would not actually have as much impact well 83-4 is uniform. This is a conservative assumption because the water The slope of the mounded water table between the outfall and monitoring

table is uniform radially around the outfall "point".

The aquifer in the outfall area is homogeneous and the mounding the water

4.1.2 Design of Storm Drain Extension

The channel extension consists of a two-phase channel design, including a low-flow channel designed to pass base flows and an artificial flood-plain terrace to pass flood flow. The overall length of the new section of channel is approximately 500 feet with a slope of 0.015 ft/ft. The estimated base or low design flow is approximately 0.5 cfs (cubic feet per second) or 225 gpm (gallons per minute). The design flood flow value is 391 cfs which is derived from the flow capacity of the immediately upstream culvert that discharges to the new channel.

The low-flow section of channel is triangular in shape, has a maximum flow depth of 0.5 feet, 10 to 1 side slopes and has a top width of 10 feet. The artificial flood-plain section is trapezoidal in shape, has a maximum flow depth of 2.95 feet, 2.5 to 1 side slopes and has a top width of 24.8 feet. Riprap will be used in both channel phases and will have a d^{50} of 8.3 inches. The maximum riprap diameter is 12.5 inches and the riprap layer thickness is 18 inches.

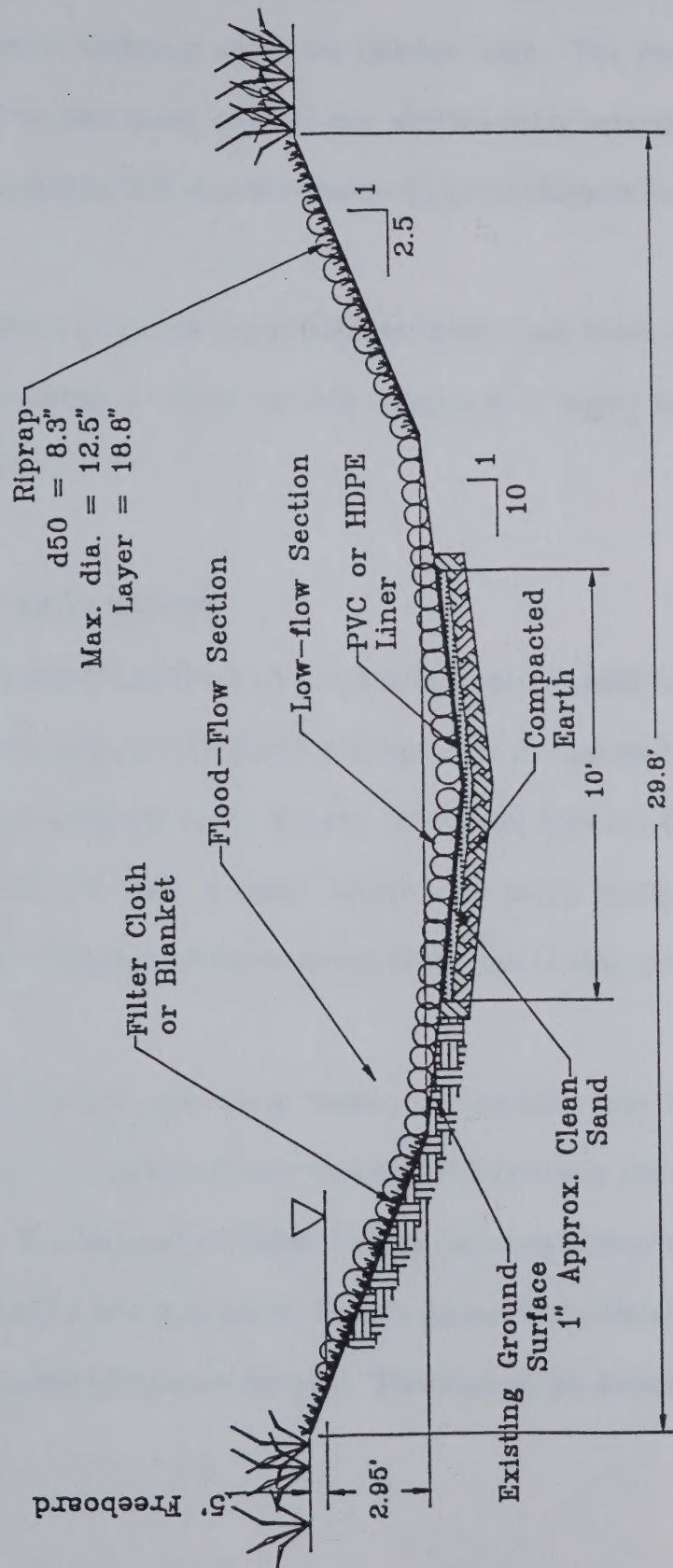
The Manning's roughness coefficients used for the channel design was increased by 10% to allow for suspended material and debris, plus increased bedload volumes accompanying flood flows. This in effect calls for a deeper channel, thus ensuring containment of flood flows. A design safety factor of 1.5 was applied for channel freeboard. The design freeboard is 0.5 feet, bringing the total channel depth to 3.95 feet with a total top width of 29.8 feet. Flow regimes in both phases are subcritical. A schematic of the two-phase channel design is shown on Figure 4.2 and the calculations

4.1.2 Design of Storm Drain Extension

The channel extension consists of a two-phase channel design, including a low-flow channel designed to pass base flows and an artificial flood-plain terrace to pass flood flows. The overall length of the new section of channel is approximately 500 feet with a slope of 0.015 ft/ft. The estimated base or low design flow is approximately 0.5 cfs (cubic feet per second) or 125 gpm (gallons per minute). The design flood flow value is 301 cfs which is derived from the flow capacity of the immediately upstream culvert that discharges to the new channel.

The low-flow section of channel is triangular in shape, has a maximum flow depth of 0.5 feet, 10 to 1 side slopes and has a top width of 10 feet. The artificial flood-plain section is trapezoidal in shape, has a maximum flow depth of 2.95 feet, 2.5 to 1 side slopes and has a top width of 24.8 feet. Riprap will be used in both channel phases and will have a K_{50} of 4.5 inches. The maximum riprap diameter is 12.5 inches and the riprap layer thickness is 18 inches.

The Manning's roughness coefficient used for the channel design was increased by 10% to allow for suggested siltation and debris plus increased bedload volumes accompanying flood flows. This in effect calls for a deeper channel, thus ensuring containment of flood flows. A design safety factor of 1.2 was applied for channel fastness. The design bedload is 0.5 feet, bringing the total channel depth to 3.95 feet with a total top width of 29.8 feet. Flow regimes in both phases are subcritical. A comparison of our two-phase channel design is shown on Figure 4.2 and the calculations



Not To Scale

HLF20-91

Figure 4.2: Storm Sewer Extension
Cross-Section

are shown in Table 4.1. The new channel is designed to extend 390 feet from the existing concrete bulkhead under the railroad track. The meanders of the previous channel will be eliminated with the new channel being essentially straight. The final design of the channel will be performed by the City of Helena Engineering Department.

After completion of the new storm drain extension, water levels in peripheral monitoring wells and piezometers will be carefully monitored to assess the impacts of the storm drain extension.

4.2 VEGETATIVE COVER

Revegetation of the landfill area is a very critical part of landfill closure operations. The vegetation and subsequent landfill soil type are the parameters most important in maintaining an adequate water balance. If the soil does not store enough water, the vegetation will not have a water source and heavy precipitation events or the accumulation of several moderate events could lead to deep percolation of water.

Two feet of the soil specifically chosen for landfill cover by the City will store approximately 3 to 5 inches of water based on SCS estimates (Montana Irrigation Guide, SCS, 1988). This will provide buffer storage for heavy precipitation periods while the vegetation uses the stored moisture. Pasture grasses in the Helena area (SCS, 1988) can use up to 21 inches of moisture per year. This is above the average annual precipitation.

are shown in Table 4.1. The new channel is designed to extend 350 feet from the existing concrete bulkhead under the railroad track. The meanders of the previous channel will be eliminated with the new channel being essentially straight. The final design of the channel will be performed by the City of Helena Engineering Department.

After completion of the new storm drain extension, water levels in peripheral flooding wells and piezometers will be carefully monitored to assess the impact of the storm drain extension.

4.3 VEGETATIVE COVER

Revegetation of the landfill area is a very critical part of landfill closure operations. The vegetation and subsequent landfill soil type are the parameters most important in maintaining an adequate water balance. If the soil does not store enough water, the vegetation will not have a water source and heavy precipitation events or the accumulation of several moderate events could lead to deep percolation of water.

Two feet of the soil specifically chosen for landfill cover by the City will store approximately 2 to 3 inches of water based on SCS estimates (Montana Irrigation Guide, SCS, 1988). This will provide buffer storage for heavy precipitation periods while the vegetation uses the stored moisture. Future studies in the Helena area (SCS, 1988) can use up to 21 inches of moisture per year. This is above the average annual precipitation.

Parameters	Value	Unit	Source
Top of channel	490	ft	Air photo
Channel slope	0.0148	ft/ft	Bulkhead outlet - midway between sections 8 & 9
Base flow	0.446	cfs	Estimated
	200	gpm	
100 year flood flow	391	cfs	Capacity of 60" R.C.P.

Channel Capacity Calculations

I. RIPRAP CALCULATIONS

- $$d50 = 12 \left(\frac{118 Q S_b^{13/6}}{r/p} \right)^{2/5}$$

where Q = discharge
S_b = channel slope
r = Hydraulic radius
p = wetted perimeter

$$d50 = \left[\left(\frac{12}{118} \right) \left(\frac{391}{0.0148} \right)^{13/6} (0.0805) \right]^{2/5}$$

$$= 8.3 \text{ inches}$$
- Maximum diameter = 1.5 (d50)
= 12.5 inches
- Minimum Layer
Thickness = 1.5 (dmax)
= 18.8 inches
- Riprap up side to maximum expected depth of flow
- A filter cloth should be used underlying the riprap, or a filter blanket using:

d 15 riprap	d 15 filter
----- <= 5 ;	----- <= 5
d 85 filter	d 85 base

SOURCE: EPA, 1976. Erosion and Sediment Control.

II. MANNING'S N CALCULATION

- Manning's n = 0.0395 (d50)^{1/6}, where d50 in feet

$$n = 0.0395 (0.67)^{1/6}$$

$$= 0.0372$$

SOURCE: EPA, 1976. Erosion and Sediment Control.

- Design safety factor - increase Manning's n by 10%

$$n = 1.10 n$$

$$= 1.10 (0.0372)$$

$$= 0.041$$

SOURCE: CIVIL ENGINEERING, January 1990. "Rethinking Flood-Control Channel Design".

III. CHANNEL DESIGN

- Channel shape

Two-stage flow-channel design:

- low-flow channel designed to pass base flow
- artificial flood-plain terrace designed to pass flood flow

- Channel Design

Section	Shape	Channel Slope (ft/ft)	Side Slope (H:1V)	Bottom Width (ft)	Manni n	Flow depth (ft)	Flow Area (ft ²)	Wetted Perimeter (ft)	Calc Flow (cfs)	Top Width (ft)	Avg Velocity (fps)	Froude Number
Base	Tri	0.0148	10	NA	0.041	0.50	2.50	10.05	4.37	10.0	1.7	0.62
Flood	Trap	0.0148	2.5	10	0.041	2.95	53.76	25.94	386.35	24.8	7.2	0.86

Depth in low-flow channel at design low-flow q = 0.21

Total	3.45	390.72	24.8
With freeboard using safety factor = 1.5	3.95		29.8

SOURCE: Manning's Equation for Open Channel Flow. Chow, 1964.
CIVIL ENGINEERING, January 1990. "Rethinking Flood-Control Channel Design".

WFO/DOY
Channel Design

WFO/DOY
Channel Design

Flow	Area	Perimeter	WFO/DOY
100	100	100	100
200	200	200	200
300	300	300	300
400	400	400	400
500	500	500	500
600	600	600	600
700	700	700	700
800	800	800	800
900	900	900	900
1000	1000	1000	1000

Channel Design Calculations

1. Channel Dimensions

$$A = \frac{Q}{V} = \frac{1000 \text{ cfs}}{10 \text{ ft/s}} = 100 \text{ ft}^2$$

$$P = \frac{A}{S} = \frac{100 \text{ ft}^2}{0.01} = 10000 \text{ ft}$$

$$WFO/DOY = \frac{P}{A} = \frac{10000 \text{ ft}}{100 \text{ ft}^2} = 100 \text{ ft/ft}^2$$

$$WFO/DOY = \frac{P}{A} = \frac{10000 \text{ ft}}{100 \text{ ft}^2} = 100 \text{ ft/ft}^2$$

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2. Channel Design

$$WFO/DOY = \frac{P}{A} = \frac{10000 \text{ ft}}{100 \text{ ft}^2} = 100 \text{ ft/ft}^2$$

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3. Channel Design

$$WFO/DOY = \frac{P}{A} = \frac{10000 \text{ ft}}{100 \text{ ft}^2} = 100 \text{ ft/ft}^2$$

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$$WFO/DOY = \frac{P}{A} = \frac{10000 \text{ ft}}{100 \text{ ft}^2} = 100 \text{ ft/ft}^2$$

Flow	Area	Perimeter	WFO/DOY
100	100	100	100
200	200	200	200
300	300	300	300
400	400	400	400
500	500	500	500
600	600	600	600
700	700	700	700
800	800	800	800
900	900	900	900
1000	1000	1000	1000

Channel Design Calculations

Based on conversations with the SCS and recommendations from Nate Halubka, who has extensive experience with reseeding reclaimed areas as an employee with Grasslands, Inc., the following seed mix per acre is suggested:

5 lbs fairway crested wheatgrass

5 lbs durar hard fescue

2.5 lbs slender wheatgrass

3.5 lbs Canada wheatgrass

This seed mixture is based on the drill seeding method, if broadcast seeding is required, the seed mixture will have to be doubled. This vegetation plan is also contingent on the final usage for the reclaimed landfill site. Any changes in the vegetation plan will be submitted to the MDHES for approval before being implemented. Potential future usage of the reclaimed landfill is discussed in Section 7.0 of this closure plan.

Based on conversations with the SCS and recommendations from Nate Hahnel, who has extensive experience with reseeding wetland areas as an employee with Grassroots, Inc., the following seed mix per acre is suggested:

2 lbs. hairy wood wheatgrass

2 lbs. hard fescue

2.5 lbs. slender wheatgrass

2.5 lbs. Canada wildrye

This seed mixture is based on the drill seeding method; if broadcast seeding is required, the seed mixture will have to be doubled. This vegetation plan is also contingent on the final wage for the technical landfill site. Any changes in the vegetation plan will be submitted to the MCHES for approval before being implemented. Potential future usage of the technical landfill is discussed in Section 7.0 of this closure plan.

5.0 CLOSURE CERTIFICATION

Prior to final closure of the Helena Landfill, the City of Helena will notify users via public announcement, and an alternative disposal facility will be named. It is anticipated that the alternative facility will be the new Lewis and Clark County Landfill in conjunction with the transfer facility to be located at the present City of Helena Landfill site. This closure plan will also be made available for public inspection. Access will be restricted to all areas to prevent refuse disposal and cover damage. Access will only be allowed to the transfer station once it becomes operational.

The landfill closure shall be considered an "interim closure" until it is approved in writing by a solid waste program inspector from the Solid and Hazardous Waste Bureau of the Montana Department of Health and Environmental Sciences. When such notice is given, the landfill will be declared officially closed and the City of Helena shall surrender their Solid Waste Management System License for this site to the MDHES. The time schedule for the final closure activities is dependent on the opening date for the new Lewis and Clark County Landfill facility.

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6.0 POST CLOSURE MAINTENANCE AND MONITORING

Post closure maintenance and monitoring are necessary to ensure the long term integrity of the landfill cover. This post closure maintenance and monitoring plan fulfills the requirements set forth by the State of Montana's Class II Landfill Closure Requirements and Recommendations (April 3, 1991).

6.1 VISUAL INSPECTION - EROSION, SETTLING AND VEGETATION CONTROL

The landfill cover and drainage ditch system will be inspected annually and after major rain events to determine its integrity. The inspection will consist of checking for erosion, differential settling, and washing out of vegetation. Rills forming in the cover will be repaired to original grade and reseeded. Erosion controls such as geofabrics, straw dams, etc. may be implemented to control problem areas.

The cover will also be inspected for extensive differential settling. Differential settling could potentially result in ponded areas on the landfill cover, resulting in leachate production. Problem areas will be regraded to original grade and reseeded.

Drainage ditches will also be maintained after the landfill is closed. Ditches will be inspected for excessive erosion and erosion will be controlled with riprap, liners, or other acceptable measures. Culverts will be cleaned when necessary to maintain proper flow in the ditches.

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The landfill cover and drainage ditch system will be inspected regularly, and after major rain events to determine its integrity. The inspection will consist of checking for erosion, differential settling, and washing out of vegetation. Rills forming in the cover will be repaired to original grade and reseded. Erosion control such as geoblocks, straw bales, etc. may be implemented to control problem areas.

The cover will also be inspected for excessive differential settling. Differential settling could potentially result in ponded areas on the landfill cover, resulting in leachate production. Problem areas will be repaired to original grade and reseded.

Drainage ditches will also be maintained after the landfill is closed. Ditches will be inspected for excessive erosion and erosion will be controlled with riprap, bank, or other acceptable measures. Culverts will be cleaned when necessary to maintain proper flow in the ditches.

Repairs to the landfill cover and ditches will be performed as soon as possible after problems are discovered to avoid major damage to the cover. Small problems such as erosional rills and washed out vegetation can be handled very quickly, whereas larger problems may require more investigation and design to mitigate.

This visual inspection portion of the post-closure maintenance and monitoring plan will be ongoing until such time as the MDHES deems necessary to ensure that conditions are stable and potential for problems is minimized.

6.2 GROUNDWATER MONITORING

This post-closure groundwater monitoring plan fulfills the requirements as set forth by the State of Montana Administrative Rules, Title 16, Chapter 14, Sub-Chapter 7 - Proposed Groundwater Monitoring Rules For Landfills in Montana, and the Montana Class II Landfill Closure Requirements and Recommendations (April 3, 1991).

The proposed water quality sampling schedule for the City of Helena Landfill (Table 6.1) incorporates the comments of the MDHES and the City/County Health Department. Parameters that would be analyzed are in the analytical schedule on Table 6.2. The parameter list is based on the draft landfill groundwater monitoring requirements being developed by MDHES.

All samples will be obtained using documented and accepted sampling techniques. One duplicate and one blank sample will be obtained and analyzed per sampling event for

Repairs to the landfill cover and ditches will be performed as soon as possible after problems are discovered to avoid major damage to the cover. Small problems such as erosion, rills and washed out vegetation can be handled very quickly, whereas larger problems may require more investigation and design to mitigate.

This visual inspection portion of the post-closure maintenance and monitoring plan will be ongoing until such time as the MDHES deems necessary to ensure that conditions are stable and potential for problems is minimized.

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All samples will be obtained using documented and accepted sampling techniques. One duplicate and one blank sample will be obtained and analyzed per sampling event for

TABLE 6.1 WATER QUALITY ANALYTICAL SCHEDULE

<u>Well Number</u>	<u>Analysis</u>	<u>Date</u>
83-6 <i>no such well?</i>	Phase I Parameters	Spring, Fall
HL90-1 <i>Batch fields</i>	Phase I Parameters	Spring, Fall
HL90-2 <i>NE of landfill</i>	Phase I Parameters	Spring, Fall
HL90-3 <i>by access road to scale house</i>	Phase I Parameters	Spring, Fall
40 <i>Teachwood Lane</i>	Phase I VOCs	Spring, Fall
31 <i>Off Brady St.</i>	Phase I VOCs	Spring, Fall
5 <i>At junction of Benton and Custer Ave.</i>	Phase I VOCs	Spring, Fall
13 <i>Oakwood Ln.</i>	Phase I VOCs	Spring, Fall
75 <i>Mitchell Ave.</i>	Phase I VOCs	Spring, Fall
EPA-1 <i>Site by overpass on LC bulch</i>	Phase I VOCs	Spring, Fall
59 <i>Dunbar Rd</i>	Phase I VOCs	Spring, Fall
52 <i>Off Custer Avenue by Cree meadow Dr.</i>	Phase I VOCs	Spring, Fall

Note: Because private well are sometimes difficult to access, nearby wells may be substituted, if necessary.

NOTE: Phase I parameters include all parameters listed above.
Phase I VOCs include parameters listed in item number 27.

TABLE 6.1 WATER QUALITY ANALYTICAL SCHEDULE

Well Number	Analyte	Date
HI-90-1	Phase I Parameters	Spring, Fall
HI-90-2	Phase I Parameters	Spring, Fall
HI-90-3	Phase I Parameters	Spring, Fall
HI-90-4	Phase I Parameters	Spring, Fall
HI-90-5	Phase I VOCs	Spring, Fall
HI-90-6	Phase I VOCs	Spring, Fall
HI-90-7	Phase I VOCs	Spring, Fall
HI-90-8	Phase I VOCs	Spring, Fall
HI-90-9	Phase I VOCs	Spring, Fall
HI-90-10	Phase I VOCs	Spring, Fall
HI-90-11	Phase I VOCs	Spring, Fall
HI-90-12	Phase I VOCs	Spring, Fall
HI-90-13	Phase I VOCs	Spring, Fall
HI-90-14	Phase I VOCs	Spring, Fall
HI-90-15	Phase I VOCs	Spring, Fall

Note: Because private wells are sometimes difficult to locate, nearby wells may be

replenished, if necessary.

TABLE 6.2 GROUNDWATER MONITORING PARAMETERS

- | | |
|-----------------------------------|----------------------------|
| 1. Ammonia (as N) | 14. Total Dissolved Solids |
| 2. Bicarbonate (HCO_3) | 15. Total Suspended Solids |
| 3. Calcium | 16. Specific Conductance |
| 4. Carbonate | 17. pH |
| 5. Chloride | 18. Arsenic |
| 6. Iron | 19. Barium |
| 7. Magnesium | 20. Cadmium |
| 8. Manganese, dissolved | 21. Chromium |
| 9. Nitrate (as N) | 22. Cyanide |
| 10. Potassium | 23. Lead |
| 11. Sodium | 24. Mercury |
| 12. Sulfate (SO_4) | 25. Selenium |
| 13. Chemical Oxygen Demand (COD) | 26. Silver |
27. The following volatile organic compounds (VOCs by EPA Method 8240):
- | | |
|-----------------------------|-----------------------------|
| ◦ Benzene | ◦ Dichlorodifluoromethane |
| ◦ Bromochloromethane | ◦ 1,1-Dichloroethane |
| ◦ Bromodichloromethane | ◦ 1,2-Dichloroethane |
| ◦ cis-1,3-Dichloropropene | ◦ Iodomethane |
| ◦ Trans-1,3-Dichloropropene | ◦ Methylene chloride |
| ◦ 1,4-Difluorobenzene | ◦ 1,1-Dichloroethene |
| ◦ Ethylbenzene | ◦ trans-1,2-Dichloroethane |
| ◦ Ethyl methacrylate | ◦ Styrene |
| ◦ 4-Bromofluorobenzene | ◦ 1,1,2,2-Tetrachloroethane |
| ◦ Bromoform | ◦ Toluene |
| ◦ Bromomethane | ◦ 1,1,1-Trichloroethane |
| ◦ Carbon tetrachloride | ◦ 1,1,2-Trichloroethane |
| ◦ Chlorobenzene | ◦ Trichloroethene |
| ◦ Chlorodibromomethane | ◦ Trichlorofluoromethane |
| ◦ Chloroethane | ◦ 1,2,3-Trichloropropane |
| ◦ 2-Chloroethyl vinyl ether | ◦ Vinyl acetate |
| ◦ Chloroform | ◦ Vinyl chloride |
| ◦ Chloromethane | ◦ Xylene |
| ◦ Dibromomethane | |

NOTE: Phase I parameters include all parameters listed above.
Phase I VOC's include parameters listed in item number 27.

TABLE 2.2 GROUNDWATER MONITORING PARAMETERS

1.	Ammonia (as N)	14.	Total Dissolved Solids
2.	Bicarbonate (HCO_3^-)	15.	Total Suspended Solids
3.	Calcium	16.	Specific Conductance
4.	Carbonate	17.	pH
5.	Chloride	18.	Arsenic
6.	Iron	19.	Barium
7.	Magnesium	20.	Cadmium
8.	Manganese, dissolved	21.	Chromium
9.	Nitrate (as N)	22.	Cyanide
10.	Potassium	23.	Lead
11.	Sodium	24.	Mercury
12.	Sulfate (SO_4^{2-})	25.	Selenium
13.	Chemical Oxygen Demand (COD)	26.	Silver
27.	The following volatile organic compounds (VOCs) by EPA Method 8240:		
	Benzene		Dichlorodifluoromethane
	Bromochloromethane		1,1-Dichloroethane
	Bromodichloromethane		1,2-Dichloroethane
	cis-1,2-Dichloropropene		Iodomethane
	trans-1,2-Dichloropropene		Methylene chloride
	1,1-Dichloroethene		1,1-Dichloroethane
	1,1,1-Trichloroethane		trans-1,2-Dichloroethane
	1,1,2-Dichloroethane		Ethylene
	1,1,2,2-Tetrachloroethane		1,1,2,2-Tetrachloroethane
	Bromobenzene		Toluene
	Bromonitrobenzene		1,1,1-Trichloroethane
	Carbon tetrachloride		1,1,2-Trichloroethane
	Chlorobenzene		Trichloroethane
	Chlorodibromomethane		Trichlorofluoromethane
	Chloroethane		1,2,3-Trichloropropane
	2-Chloroethyl vinyl ether		Vinyl acetate
	Chloroform		Vinyl chloride
	Chloromethane		Xylene

NOTE: Phase I parameters include all parameters listed above.
Phase I VOCs include parameters listed in item number 27.

quality control and quality assurance. Monitoring results will be submitted to the MDHES and City/County Health Department when the results are obtained and validated.

6.3 METHANE MONITORING

Methane monitoring in the vicinity of the Helena Landfill has been carried out by the Helena Fire Department since the early 1980s through 1990. This monitoring consisted of combustible gas surveys in monitoring wells HL-1 through HL-7 and the basements of the YMCA and State Armory Buildings. During this time the highest concentrations of methane were observed in well HL-4 and range from 2.2 to 6.4% (personal communication, Fritz Zettal, City of Helena Fire Department, January 1990).

At the request of MDHES, a new program encompassing the northern part of the landfill area was implemented in Spring 1991. The Helena Fire Department sampled the YMCA and Armory basements as well as monitoring wells 83-7, 82-3, HL90-1 and 82-2. Values over 100% of the lower explosive limit (LEL) were obtained using a gas-Tech Tank Techtor in wells 83-7 and 82-3. The LEL for methane is 5% or 50,000 parts per million (ppm). It is important to note that Tank Techtor is calibrated to hexane and that methane values over 42% LEL will register a 100% LEL reading on the instrument.

To verify the results of the findings, well 82-3 was retested with the Tank Techtor at the same time as a grab air sample was obtained. At this time the Tank Techtor gave a reading of about 60% LEL. Adjusted for methane this equals $(60\% \times .42 = 25.2\%)$ or

quality control and quality assurance. Monitoring results will be submitted to the
MCHES and City/County Health Department when the results are obtained and
verified.

6.3 METHANE MONITORING

Methane monitoring in the vicinity of the Helena Landfill has been carried out by the
Helena Fire Department since the early 1980s through 1990. This monitoring consisted
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communication, Fritz Zittel, City of Helena Fire Department, January 1990).

At the request of MCHES, a new program encompassing the northern part of the
landfill area was implemented in Spring 1991. The Helena Fire Department sampled
the YMCA and Attorney basements as well as monitoring wells 83-2, 83-3, HL80-1 and
83-2. Values above 100% of the lower explosive limit (LEL) were obtained using a gas
Tech Tank Technor in wells 83-2 and 83-3. The LEL for methane is 5% or 50,000 parts
per million (ppm). It is important to note that Tank Technor is calibrated to hexane and
that methane values over 45% LEL will register a 100% LEL reading on the instrument.

To verify the results of the Tank Technor, well 83-3 was retested with the Tank Technor at the
same time as a grab air sample was obtained. At this time the Tank Technor gave a
reading of about 60% LEL. Adjusted for methane this equals $(60\% \times 45 = 27\%)$ or

12600 ppm). On a no methane response mode the instrument showed a 0% LEL reading indicating that the gas was essentially all methane. The air sample was sent to a laboratory for a routine natural gas analysis. This analysis indicated that methane was the only organic gas present. The concentration of methane was 3000 ppm, a discrepancy of about four times. This indicates that portable field analyzers may be quite inaccurate and that results should be correlated to laboratory samples. Table 6.3 shows the results of methane monitoring with the organic vapor analyzer. These results indicate that the areal extent of methane gas is limited to the buried refuse areas and that the concentrations of methane at selected sites is well below the lower explosive limit.

82-2

Post-closure monitoring at the Helena Landfill will encompass the entire area as well as peripheral areas. Table 6.4 shows wells which will be monitored on a semiannual basis and the method of analysis. Monitoring will consist of testing a group of wells, that have previously high methane concentrations, with an organic vapor analyzer such as a Foxboro OVA 128GC or a Gastech Tank Techtor. In addition to this, an air sample will be obtained at the well with the highest detected methane concentration. This sample will be analyzed at a laboratory and will serve to establish a reliable correlation between the organic vapor analyzing instrument and actual values. Wells peripheral to landfill that have not previously shown detectable concentrations of methane will be analyzed with colorometric tubes. These tubes can detect the presence of methane at low concentrations and have proven to be a reliable methane detection instrument. The

*should
sample
quarterly*

Note: See Exhibit 1 for site locations.

12500 ppm). On a no methane response mode the instrument showed a 0% LEL reading indicating that the gas was essentially all methane. The air sample was sent to a laboratory for a routine natural gas analysis. This analysis indicated that methane was the only organic gas present. The concentration of methane was 3000 ppm, a discrepancy of about four times. This indicates that portable field analyzers may be quite inaccurate and that results should be correlated to laboratory samples. Table 6.3 shows the results of methane monitoring with the organic vapor analyzer. These results indicate that the total extent of methane gas is limited to the bonded refuse areas and that the concentrations of methane at selected sites is well below the lower explosive limit.

Post-fire monitoring at the Melrose Landfill will encompass the entire area as well as peripheral areas. Table 6.4 shows wells which will be monitored on a semiannual basis and the method of analysis. Monitoring will consist of testing a group of wells that have previously high methane concentrations, with an organic vapor analyzer such as a Foxboro OVA 1250C or a Gastech Tank Tester. In addition to this, an air sample will be obtained at the well with the highest detected methane concentration. This sample will be analyzed at a laboratory and will serve to establish a reliable correlation between the organic vapor analyzing instrument and actual values. Wells peripheral to landfill that have not previously shown detectable concentrations of methane will be analyzed with colorimetric tubes. These tubes can detect the presence of methane at low concentrations and have proven to be a reliable methane detection instrument. The

TABLE 6.3 METHANE MONITORING SITES

HL-7	- Organic vapor instrument
HL90-2	- Organic vapor instrument
HL90-1	- Colorimetric tube
I-5	- Colorimetric tube
HL90-3	- Colorimetric tube
82-3	- Organic vapor instrument
EPA-4	- Organic vapor instrument
83-7	- Organic vapor instrument
82-2	- Organic vapor instrument
82-4	- Organic vapor instrument
Scale House	- Colorimetric tube
Elk River	- Colorimetric tube
EPA-2	- Organic vapor instrument
EPA-1	- Organic vapor instrument
HL-1	- Colorimetric tube
YMCA	- Colorimetric tube
Armory	- Colorimetric tube

Note: See Exhibit 1 for site locations.

TABLE 6.3 METHANE MONITORING SITES

HL-7	- Organic vapor instrument
HL-90-2	- Organic vapor instrument
HL-90-1	- Colorimetric tube
1-2	- Colorimetric tube
HL-90-3	- Colorimetric tube
82-5	- Organic vapor instrument
EW-4	- Organic vapor instrument
82-1	- Organic vapor instrument
82-2	- Organic vapor instrument
82-4	- Organic vapor instrument
Soils H-1	- Colorimetric tube
ER H-1	- Colorimetric tube
EW-3	- Organic vapor instrument
EW-1	- Organic vapor instrument
HL-1	- Colorimetric tube
YMCA	- Colorimetric tube
A-1	- Colorimetric tube

Note: See Exhibit 1 for site locations.

TABLE 6.4: Concentrations of methane in parts per million from selected locations.

LOCATION	DATE	ORGANIC VAPORS DETECTED			SITE CONDITIONS
		BACKGROUND	TOTAL	METHANE	
MPC Office	07-Jul-91	6.4	6.4	6.4	Office Basement
YMCA	07-Jul-91	0	0	0	Fire Department Reading
Armory	07-Jul-91	0	0	0	Fire Department Reading
82-3	07-Jul-91	6.3	12	11	next to landfill shop has had prior high values
HL90-3	07-Jul-91	6.4	6.4	6.5	near pavement and Railroad sparse vegetation
HL90-1	07-Jul-91	5.7	5.7	5.7	near compacted dirt road sparse vegetation
HL90-2	07-Jul-91	5.4	5.4	5.4	200' from pond good vegetative cover
82-2	07-Jul-91	5.8	5.8	6	in railroad cut sparse vegetation
EPA-1	07-Jul-91	6	22	16	10' from pavement good vegetative cover
83-7	07-Jul-91	5.4	50	50	near railroad tracks good vegetative cover
82-4	07-Jul-91	6.4	300	300	center of landfill good vegetative cover near well
EPA-4	07-Jul-91	6.9	7.1	7.3	near unpaved road sparse vegetation
HLP91-1	07-Jul-91	4.4	4.6	4.6	15' from drain channel sparse vegetation
I-2	07-Jul-91	NO ACCESS	NO ACCESS	NO ACCESS	golf course irrigation well being pumped
I-4	07-Jul-91	NO ACCESS	NO ACCESS	NO ACCESS	in locked well house
Elk River	07-Jul-91	5.6	5.6	5.6	in office/shop building
Landfill Office	07-Jul-91	6.8	6.8	6.8	in scalehouse
HL-1	07-Jul-91	6	5.9	6	on cut slope below paved road 8' from compacted dirt road
HL-7	07-Jul-91	4.8	4.8	4.8	sparse vegetation
I-5	07-Jul-91	6.6	6.6	6.6	near compacted dirt parking lot and concrete sidewalk
I-6	07-Jul-91	NO ACCESS	NO ACCESS	NO ACCESS	sparse vegetation
EPA-2	07-Jul-91	5.6	5.1	5.1	near paved parking lot good vegetative cover
EPA-3	07-Jul-91	NO ACCESS	NO ACCESS	NO ACCESS	near paved parking lot and paved street
Calibration Standard	08-Jul-91	6.5	108	100	100 ppm methane calibration standard

monitoring with colorimetric tubes will be performed to assure that the area in which methane gas is present has not enlarged.

Due to the potential for methane accumulation in any part of the landfill, no excavation or construction shall be allowed in or adjacent to the landfill without proper methane surveys being performed. Federal safety regulations, (OSHA), outline the proper procedures to follow in such a case. The City of Helena shall notify all departments that may potentially access the landfill area of these procedures. In Appendix D is a letter sent to all of the utility companies that could be excavating in the landfill area. In addition, this letter was also sent to Carroll College, Elkriver Concrete, and necessary City of Helena personnel.

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7.0 FUTURE LAND USE

The City of Helena has designated no specific use for the reclaimed landfill area at this time. A personal communication with Mr. Randy Lilje of the City of Helena Parks Department in June 1991, indicated that the land use currently being considered (but not committed to) would be a grassed park area similar to that of Centennial Park. This use would dictate that irrigation of the grass would need to be implemented and a soil moisture and water balance control system similar to that at Centennial Park would need to be implemented. Final land use will be determined by the City after all possible options have been evaluated.

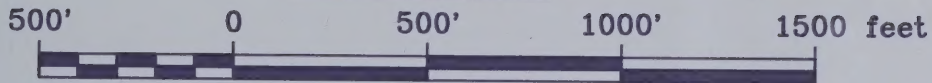
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8.0 REFERENCES

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Scale



Project:

City of Helena Landfill

Sheet Title:

Domestic and Monitoring Well
Locations and Potentiometric
Contour Map

Drawn: GJF

Checked: SD

Approved: RH

Date: 8/9/91

Rev. #:

Hydrometrics, Inc.

Consulting Scientists and Engineers

2727 Airport Road

Helena, Montana 59601

(406) 443-4150

EXHIBIT

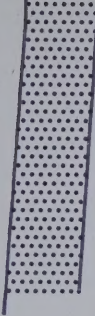
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HLF18-91



ewer Line

12" Sewer Line



Project:

City of Helena Landfill

Sheet Title:

Closure Plan - Final Grading
and Drainage

Drawn: SD

Checked: SD

Approved: MKB

Date: 7/7/91

Rev. #:

Hydrometrics, Inc.

Consulting Scientists and Engineers

2727 Airport Road

Helena, Montana 59601

(406) 443-4150

Exhibit No.

3

Revised Helena Landfill Closure Plan

Submitted To:

Montana Department of Health
and Environmental Sciences

Submitted By:

City of Helena
Helena, Montana

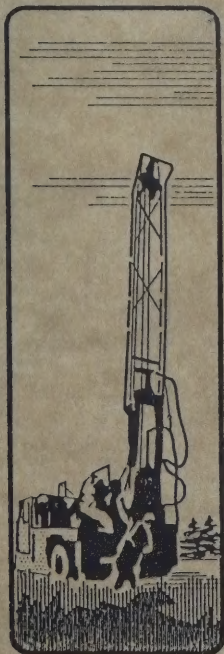


Prepared By:

Hydrometrics, Inc.

Consulting Scientists and Engineers
Helena, Montana 59601

March 1993

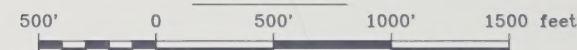




Legend

- HL-2 ■ Piezometer
- 83-5 ○ Abandoned Monitoring Well
- 83-6 ● Monitoring Well
- I-6 ▲ Irrigation Well
- 80 □ Domestic Well
- Infiltration Gallery
- 3950 — Potentiometric Contour (Dashed Where Inferred)
- - - - - Approx. Location Of Storm Drain

Scale



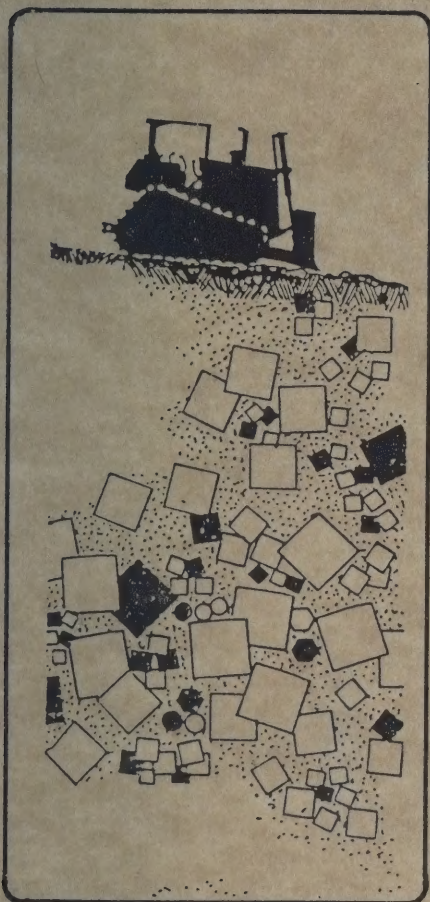
Project:
City of Helena Landfill

Sheet Title:
Domestic and Monitoring Well
Locations and Potentiometric
Contour Map

Hydrometrics, Inc.
Consulting Scientists and Engineers
2727 Airport Road
Helena, Montana 59601
(406) 443-4150

Drawn: GJP
Checked: SD
Approved: RH
Date: 8/9/91
Rev. #:

EXHIBIT
1
HLF18-91



Revised Helena Landfill Closure Plan

Submitted To:

Montana Department of Health
and Environmental Sciences

Submitted By:

City of Helena
Helena, Montana



Prepared By:

Hydrometrics, Inc.

Consulting Scientists and Engineers
Helena, Montana 59601

March 1993

Lewis & Clark
County Fairgrounds

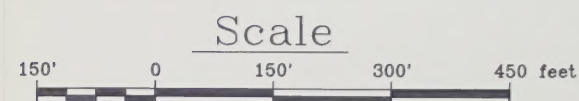




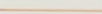
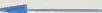
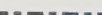
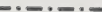
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	10	GJF	4/8/93	Add Contours
	11	GJF	4/8/93	Extend Map to Lyndale Avenue

This engineering plan view illustrates a sewer system layout. The map includes the following features and labels:

- Topographic Features:**
 - Existing Reclaimed Landfill Finish Grade Contours (indicated by orange contour lines with elevations such as 3950, 3960, 3970, 3980, and 3990).
 - LYNDALE AVENUE (at the bottom of the map).
 - LAST CHANCE GULCH (on the right side of the map).
- Existing Infrastructure:**
 - Existing Storm Sewer Inlet (two locations).
 - Existing Arched Conc. Storm Sewer Outfall.
 - Existing Concrete Culvert.
 - Existing Storm Sewer (60") (indicated by a dashed line).
 - Existing Parking Lot.
 - Y.M.C.A. (shaded building footprint).
 - ARMORY (shaded building footprint).
- Proposed Infrastructure:**
 - Proposed Sewer Lines (24" and 12" lines shown as dashed lines).
 - Proposed Storm Sewer Layout (indicated by blue arrows and dashed lines).
 - Proposed Pits (PIT 1 through PIT 18, shown as yellow dashed outlines).
 - Proposed CMP Culvert (at the top left).



Legend

-  Proposed Finish Grade Contours
-  Existing Contours
-  General Surface Water Flow Direction
-  Storm Sewer Line
-  Sanitary Sewer Line
-  Existing Building
-  Proposed Building
-  Railroad Tracks
-  Existing Concrete Culvert
-  Proposed CMP Culvert
-  Landfill Cell Extent

City Of Helena

Final Grading Plan

Hydrometrics, Inc.
Consulting Scientists and Engineers
2727 Airport Road
Helena, Montana 59601
(406) 443-4150

Drawn: GJF
Checked: SD
Approved: MRW
Date: 4/1/93
Rev. #: 2

EXHIBIT 3
HLF27931

NORTH



LEGEND

-
- The diagram illustrates a landfill site with the following features:
- Final Grade Contour and Elevation:** A line with an arrow pointing to the value 3960.
 - Outline and Number of Landfill Pit:** A rectangular outline containing the text "PIT 17".
 - Direction of Runoff Flow:** A blue arrow pointing towards the bottom right.

OF HELENA LANDFILL AL GRADING PLAN



SCALE
1 inch = 100 feet

NO.	BY	DATE	DESCRIPTION
1			
2			
3			
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6			
7			
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Project:

City of Helena Landfill

Sheet Title:

Closure Plan - Final Grading
and Drainage

Hydrometrics, Inc.

Consulting Scientists and Engineers
2727 Airport Road
Helena, Montana 59601
(406) 443-4150

Drawn: SD
Checked: SD
Approved: MKB
Date: 7/7/01
Rev. #:

Exhibit No.

3

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Submitted to:

Montana Department of Health and
Environmental Sciences
Solid and Hazardous Waste Bureau
Cogswell Building
Helena, MT 59620

By:

City of Helena
316 North Park
Helena, MT 59620

Prepared by:

Hydrometrics, Inc.
2727 Airport Road
Helena, MT 59601

September 1991

REVISED March 1993

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- EXHIBIT 2. EXTENT OF DICHLORODIFLUOROMETHANE FOR
SPRING 1992 SAMPLING EVENT

- EXHIBIT 3. FINAL COVER GRADING AND DRAINAGE PLAN

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HELENA LANDFILL CLOSURE PLAN REV. 10/2011

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APPENDIX B. STORM DRAIN OUTFALL FLOW MEASUREMENTS

APPENDIX C. COVER SOIL TESTING DATA

APPENDIX D. TOPSOIL DATA

APPENDIX E. METHANE INFORMATION

HELENA LANDFILL CLOSURE PLAN

REVISED 3-93

1.0 INTRODUCTION

This closure plan for the City of Helena Landfill is designed to meet all requirements set forth by the State of Montana in the Administrative Rules of Montana, Title 16, Chapter 14 - Solid Waste Management, Sub-chapter 5 - Refuse Disposal; Sub-chapter 7 - Proposed Groundwater Monitoring Rules for Landfills in Montana; and Subtitle D closure requirements as set forth under 40 CFR Parts 257 and 258. The Montana regulations are outlined in the Montana Department of Health and Environmental Sciences (MDHES), Solid and Hazardous Waste Bureau's document of April 3, 1991, entitled "Class II Landfill Closure Requirements and Recommendations".

The final closure date of the City of Helena Landfill is dependant on opening of the new Lewis and Clark County "Site E" Landfill (which is in the permitting process at this time), or arranging a different interim waste disposal alternative. Due to the uncertainty of the opening date of the new landfill, the final closure date for the City of Helena Landfill cannot be given, however, the City is committed to closing the landfill before October 9, 1993. The City of Helena plans to operate under an interim closure for this period and will coordinate all final closure activities with the MDHES at the appropriate time.

1.1 OPERATING HISTORY OF HELENA LANDFILL

The City of Helena Landfill is located east of Carroll College, west of Memorial Park, and North of Lyndale Avenue (Figure 1.1). The landfill encompasses about 37 acres of active and inactive landfill areas. The landfill was activated in the late 1800s when open burning was the primary disposal method. The present landfill operations were begun in 1970 when sanitary landfill regulations were promulgated and open burning ceased (EPA, 1989).

The Helena Landfill has accepted an average of 75 to 80 tons of domestic refuse per day since the early 1970s (Personal communication, Willie Miller - City of Helena Landfill Supervisor, July, 1990). Several filled areas have been deactivated and reclaimed over the history of the Helena Landfill.

Refuse was initially placed south of the railroad tracks and this area has been reclaimed and is now Centennial Park (Figure 1.1). Centennial Park is a grassed area used for recreational activities such as soccer, baseball, and jogging. The present active landfill area is between two east-west running railroad tracks north of Centennial Park (Figure 1.1), and has been active since 1982.

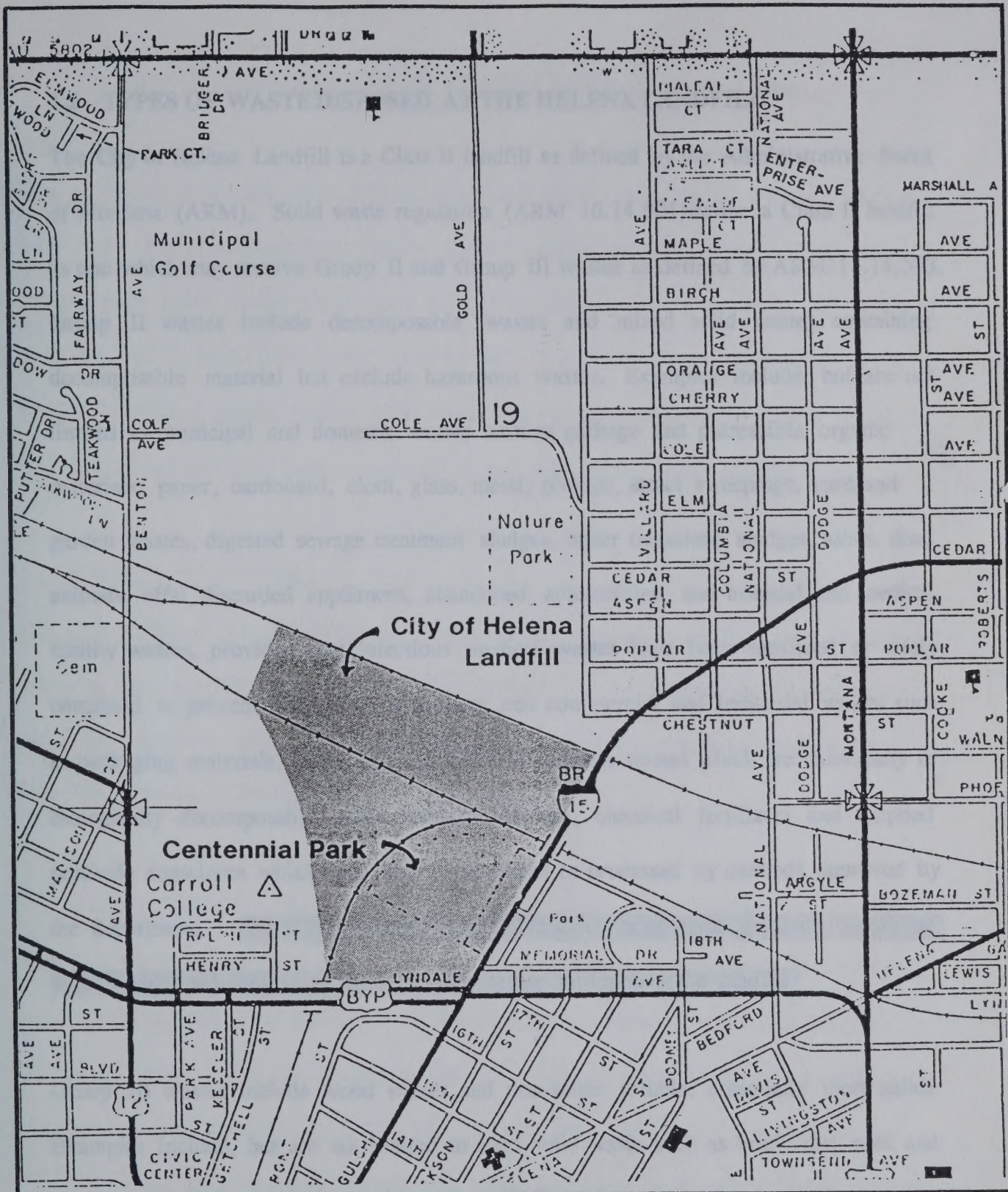


Figure 1.1: City of Helena Landfill
Location Map

1.2 TYPES OF WASTE DISPOSED AT THE HELENA LANDFILL

The City of Helena Landfill is a Class II landfill as defined by the Administrative Rules of Montana (ARM). Solid waste regulation (ARM 16.14.504) define a Class II landfill as one which may receive Group II and Group III wastes as defined by ARM 16.14.503. Group II wastes include decomposable wastes and mixed solid wastes containing decomposable material but exclude hazardous wastes. Examples include, but are not limited to municipal and domestic wastes such as garbage and putrescible organic materials, paper, cardboard, cloth, glass, metal, plastics, street sweepings, yard and garden wastes, digested sewage treatment sludges, water treatment sludges, ashes, dead animals, offal, discarded appliances, abandoned automobiles, and hospital and medical facility wastes, provided that infectious medical wastes have been sterilized or safely contained to prevent the danger of disease; and commercial and industrial wastes such as packaging materials, liquid or solid industrial process wastes which are chemically or biologically decomposable, crop residues, manure, chemical fertilizers and emptied pesticide containers which have been triple rinsed or processed by methods approved by the department. The City of Helena Landfill also contains some asbestos containing wastes which was buried along with other refuse throughout the landfill.

Group III wastes include wood wastes and non-water soluble, essentially inert solids. Examples include, but are not limited to inert solid waste such as brick, dirt, rock and concrete; wood materials, brush, lumber, and vehicle tires; and industrial mineral wastes which are essentially inert and non-water soluble, and do not contain hazardous waste constituents.

2.0 HYDROGEOLOGY OF THE HELENA LANDFILL AREA

Several studies evaluating soils, hydrogeology and water quality in the Helena Landfill area have been conducted in recent years. These studies include EPA Field Investigation Team studies in 1987 and 1989, Hydrometrics, Inc.'s studies in 1982, 1983 and 1990, and F and M Consultants' study in 1982. The United States Geological Survey has also conducted several studies of the geology and hydrogeology of the Helena Valley. All of these studies have been considered in the preparation of this closure plan.

2.1 GEOLOGIC SETTING

The City of Helena Landfill is located at the edge of the Helena Valley near the base of Mount Helena. The hills and mountains peripheral to the Helena Valley are folded and faulted igneous, sedimentary and metamorphic rocks that range in geological age from Precambrian to Tertiary (Wilke and Coffin, 1973).

The Helena Landfill is at the mouth of Last Chance Gulch at the southern edge of the Helena Valley. The gulch in this area is underlain with alluvial deposits of Quaternary and Tertiary geological age that are in geological contact with igneous bedrock at Carroll College and limestone bedrock beneath the U.S. National Guard Armory and YMCA buildings adjacent to Last Chance Gulch. The alluvial stream and fan deposits are indistinguishable and are composed of layers, lenses and mixtures of unconsolidated clay, silt, sand, gravel and cobbles (Coffin, 1971). The alluvial material is variable in lithology with limestone and dolomite clasts from the Precambrian Helena Dolomite Formation,

and clasts of intrusive igneous rocks of Cretaceous age being common. The former has been uplifted and exposed to the south of Helena, and the latter is present as an elevated bedrock hill in the Carroll College area. Alluvial fan and stream deposits were probably deposited by an interconnecting network of paleochannels which resulted in the heterogeneous alluvium at the mouth of Last Chance Gulch.

In the vicinity of the Bill Roberts Golf Course (just north of the landfill), the Quaternary alluvium has been extensively placer mined for gold. The dredge tailings vary in thickness from 25 to 50 feet and are underlain by unconsolidated to semi-consolidated sediments of Tertiary age and by alluvium too deep to dredge. The Tertiary sediments vary in thickness from many hundreds of feet in the central Helena Valley to relatively thin deposits along the valley's edges (Hydrometrics, 1982). These Tertiary sediments are underlain by the Precambrian Helena Dolomite Formation and possibly the Empire and Spokane Formations. The Helena Dolomite is a siliceous dolomite with subordinate limestone. Wells located just north of Carroll College are completed in this formation and yield only small quantities of water. An irrigation well drilled in the Bill Roberts Golf Course encountered a green argillite at a depth of about 200 feet. This argillite is likely a Precambrian age rock of the Empire and Spokane Formation, or the Marsh Formation. The bedrock mound that forms the hill on which Carroll College sits is an igneous intrusive (diorite porphyry) which intruded upward through the older formations.

2.2 HYDROGEOLOGY

Groundwater in the landfill area occurs both in the alluvium and the underlying bedrock. North of the landfill, groundwater occurs in dredge piles left by historic mining at the mouth of Last Chance Gulch, and in the semi-consolidated Tertiary sediments. These sediments are heterogenous in nature.

Groundwater flow in the study area is generally to the north and northwest with an average gradient of about 0.05 ft/ft. Exhibit 1 shows a potentiometric surface map of the alluvial system during the Spring 1992 monitoring event (Fall 1992 data has been collected and data as well as an annual report will be submitted to MDHES by the City/County water quality district). Hydrometrics (1982) estimated the groundwater flow rate through the alluvium underlying the landfill to be approximately 28 gallons per minute. This flow rate is based on a hydraulic conductivity of 100 gpd/ft² (F and M Consultants, 1982), an average saturated thickness of 20 feet, and an average valley width of 400 feet. Assuming a porosity of 25% for the alluvium, the average groundwater velocity in the vicinity of the landfill is estimated to be 2.68 ft/day. Based on additional data obtained by Hydrometrics, Inc. in 1990, these earlier velocity and flow estimates could be as much as an order of magnitude low. Table 2.1 shows hydrogeological characteristics of selected sites in the landfill area. At these sites, transmissivity (the ability to transmit water) of the alluvium ranges from 1,680 gpd/ft to 33,000 gpd/ft (Hydrometrics, 1990). This broad range is due to the heterogeneous nature of the alluvium in the landfill area.

- Not enough data. Measure more wells!
- when?

Table 2.1: Hydrogeologic Characteristics Of Selected Sites

WELL OR PIT	GEOLOGIC MATERIAL	TRANSMISSIVITY	HYDRAULIC CONDUCTIVITY
GOLF COURSE TW-	Poorly sorted alluvium - sand, gravel, cobbles and minor clay	7920 gpd/ft	2×10^{-3} cm/sec
GOLF COURSE TW-	Semi-consolidated bedrock "Caliche"	1680 gpd/ft	7×10^{-4} cm/sec
South Pit *	Disturbed stream channel	11,000 gpd/ft	
North Pit *	Coarse sandy gravel	33,000 gpd/ft	

* From Robert Peccia and Associates (1982) Study
For Bill Roberts Municipal Golf Course

MAP LOCATION	APPROX. SPECIFIC CAPACITY	MAP LOCATION	APPROX. SPECIFIC CAPACITY
1	0.36	36	1
5	1.25	37	0.3
6	0.41	38	0.36
7	0.81	39	1
13	0.31	40	1
15	0.24	41	0.53
16	0.32	42	0.66
19	0.5	43	0.3
20	0.43	44	0.62
21	4.28	54	0.6
24	0.18	56	3.7
26	0.008	62	0.42
27	0.01	65	0.36
28	0.07	67	0.29
29	0.07	73	0.14
30	0.47	75	1
31	0.15	78	0.67
35	0.56		

NOTE: Specific Capacities were calculated from short term pumping test data and are only approximations.

The unconsolidated alluvium varies in texture from a silty or clayey sand to medium or coarse-grained sand containing gravel and cobbles. Textural variations are likely due to the changing environment during deposition of the alluvium with the more coarse-grained materials associated with high energy outflows from Last Chance Gulch into the Ten Mile Creek drainage. As the groundwater moves out of the landfill area, to the north, the groundwater gradient flattens indicating more transmissive materials in this part of the valley.

Wells completed in bedrock southwest of the landfill exhibit much lower specific capacities (amount of water yield per foot of drawdown) than wells completed in the alluvium. Alluvial wells in the area are typically 60 to 100 feet deep, while bedrock wells are typically deeper than 250 feet. Water wells in and around the landfill area have been inventoried (Table 2.2) and are shown on Exhibit 1.

Any bedrock wells ok list?

Semi-consolidated, alluvial deposits of Tertiary age were encountered north and west of the landfill during drilling of golf course irrigation well I-3 and monitoring well HL90-1 (Exhibit 1). These semi-consolidated deposits are less transmissive than the overlying, unconsolidated alluvium and are composed of calcite cemented sands and gravels sometimes referred to as "caliche".

The thickness of the alluvium increases from a few feet near Lyndale Avenue (see Exhibit 1) to about 200 feet at golf course well I-3. Figure 2.1 is a hydrogeological cross-section based on monitoring well data from the northern landfill boundary area. A

TABLE 2.2: HELENA LANDFILL AREA WELL INVENTORY

NUMBER	ADDRESS	OWNER	DEPTH	PERFORATED ZONE
1	230 Meadow Dr.	G. Amestoy	100	---
2	233 Meadow Dr.	C. Colarchic	---	---
3	227 Greenwood	A. Holzwarth	---	44-64
4	5 Deborah Ct.	T. Johnson	100	---
5	350 Custer Ave.	S. Colvin	80	60-80
6	3119 Bridger	J. Garman	100	70-100
7	454 Vigilante	R. Stenquist	51	---
8	3107 Vigilante	C. Knutson	101	80-100
9	3130 Vigilante	C. Tielking	61	---
10	448 Russell	L. Peterman	---	---
11	472 Russell	J. Zimmerman	---	---
12	448 Paxon	M. Parriman	68	60-68
13	102 Oakwood	E. Johnson	118	78-118
14	104 Oakwood	K. Rogers	115	70-110
15	106 Oakwood	E. Darfler	140	90-140
16	3 Parr Court	C. Tilzey	65	54-64
17	105 Wedgewood	F. Robinson	---	---
18	108 Wedgewood	B. Hartman	---	---
19	119 Wedgewood	D. Clark	115	90-115
20	3 Terry Court	H. Peterson	120	80-120
21	146 Briarwood	R. Karp	52	12-52
22	154 Briarwood	R. Burger	---	---
23	114 Ridgewood	T. Berry	75	55-75
24	1130 Waukesha	E. Johnson	180	100-180
25	1703 Waukesha	M. Carmichael	---	---
26	932 Peosta	G. Daly	300	---
27	1110 Peosta	S. McCann	360	---
28	1314 Peosta	M. Johnson	278	170-270
29	1331 Peosta	R. Guse	300	120-290
30	1611 Peosta	R. Brohman	135	---
31	1430 Brady	D. Gardner	101	75-95
32	1815 Brady	W. Routzahn	220	140-220
33	1317 Hudson	C. Engstedt	---	---
34	1325 Hudson	K. Erickson	118	78-118
35	1427 Broadwater Cir.	Broadwater Vill.	215	95-215
36	3203 Cooney	Kalamity Bros.	45	38-45

--- Denotes information not found. Inventory is based on DNRC records and field investigation.

TABLE 2.2: HELENA LANDFILL AREA WELL INVENTORY

37	235 Anderson Blvd.	G. South	100	40-100
38	227 Anderson Blvd.	T. Tillo	100	40-100
39	239 Anderson Blvd.	W. Kotan	82	58-82
40	2509 Teakwood	E. Hartman	70	50-70
41	124 Meadow	Strasko	73	53-73
42	112 Meadow	W. Hill	72	52-72
43	246 Brady	Frisch	80	40-80
44	1023 Peosta	Cumley	65	55-65
45	94 Oakwood	Hanson	116	---
46	320 Custer	Colvin	---	---
47	328 Custer	Robinson	---	---
48	308 Custer	C.A. Barbeau	79	---
49	304 Custer	---	---	---
50	226 Custer	---	---	---
51	220 Custer	E. Hartze	64	---
52	Custer & Grn. Meadow	---	---	---
53	121 Dunbar	G. Kercher	---	---
54	122 Dunbar	S. Hitchcock	67	57-67
55	114 Dunbar	---	---	---
56	112 Dunbar	G. Francis	54	---
57	108 Dunbar	Bacon	---	---
58	106 Dunbar	---	---	---
59	100,102 Dunbar	Stolp	---	---
60	No Address - Trailers	---	---	---
61	78 Dunbar	J. Hayes	72	---
62	76 Dunbar	J. Bridges	80	60-80
63	110 Willow	G. Milairn	---	---
64	121 Willow	B. Bonogofsky	82	58-82
65	110 Willow	Pool	85	---
66	108 Willow	---	---	---
67	105 Willow	O'Neal	100	60-100
68	104 Willow	J. Creach	80-100	---
69	19 Willow	Horsecienda Hotel	---	---
70	11 Willow	Gardner	55	---
71	3204 Mitchell	Chamberlain	---	---
72	3208 Mitchell	Hall	---	---
73	3212 Mitchell	Tovey	72	52-72
74	3216 Mitchell	Allison	---	---
75	104 Reed	J. Creach	70	22-70

--- Denotes information not found. Inventory is based on DNRC records and field investigation.

TABLE 2.2: HELENA LANDFILL AREA WELL INVENTORY

76	Trailer Court on Reed	---	---	---
77	115 Reed	---	---	---
78	120 Reed	W. Cole	50	42-50
79	SW Corner Grn Mdw/Reed	---	---	---
80	3280 Green Meadow	Trails West	---	---
81	3300 Green Meadow	G. M. Market	---	---
82	County Fairgrounds	Fairgrounds	---	---
83	610 W. Custer	AAA Car Wash	---	---
84	500 Cole Ave.	---	---	---
85	210 Harwood	Ralston	75	15-75
86	15 Reed	C. Bryant	72	---
HL-90-1	---	City of Helena	60	40-60
HL-90-2	---	City of Helena	68	60-68
HL-90-3	---	City of Helena	79	59-79
83-6	---	City of Helena	25	19-23
83-7	---	City of Helena	40	32-37
82-1	---	City of Helena	40	14-34
82-2	---	City of Helena	43	23-43
82-3	---	City of Helena	83	43-83
82-4	---	City of Helena	79	44-74
HL-1	---	EPA	---	---
HL-2	---	EPA	---	---
HL-5	---	EPA	---	---
HL-6	---	EPA	---	---
HL-7	---	EPA	---	---
EPA1	---	EPA	54.5	39.5-54.5
EPA2	---	EPA	55.1	40.1-55.1
EPA3	---	EPA	95	85-95
EPA4	---	EPA	76.2	66.2-76.2
I-1	---	Golf Course	146	35-95
I-2	---	Golf Course	---	---
I-3	---	Golf Course	220	71-170 (Zones)
I-4	---	Batch Fields	156	60-156
I-5	---	Carroll College	550	100-550
I-6	---	Carroll College	320	100-320
I-7	---	Golf Course	---	---

--- Denotes information not found. Inventory is based on DNRC records and field investigation.

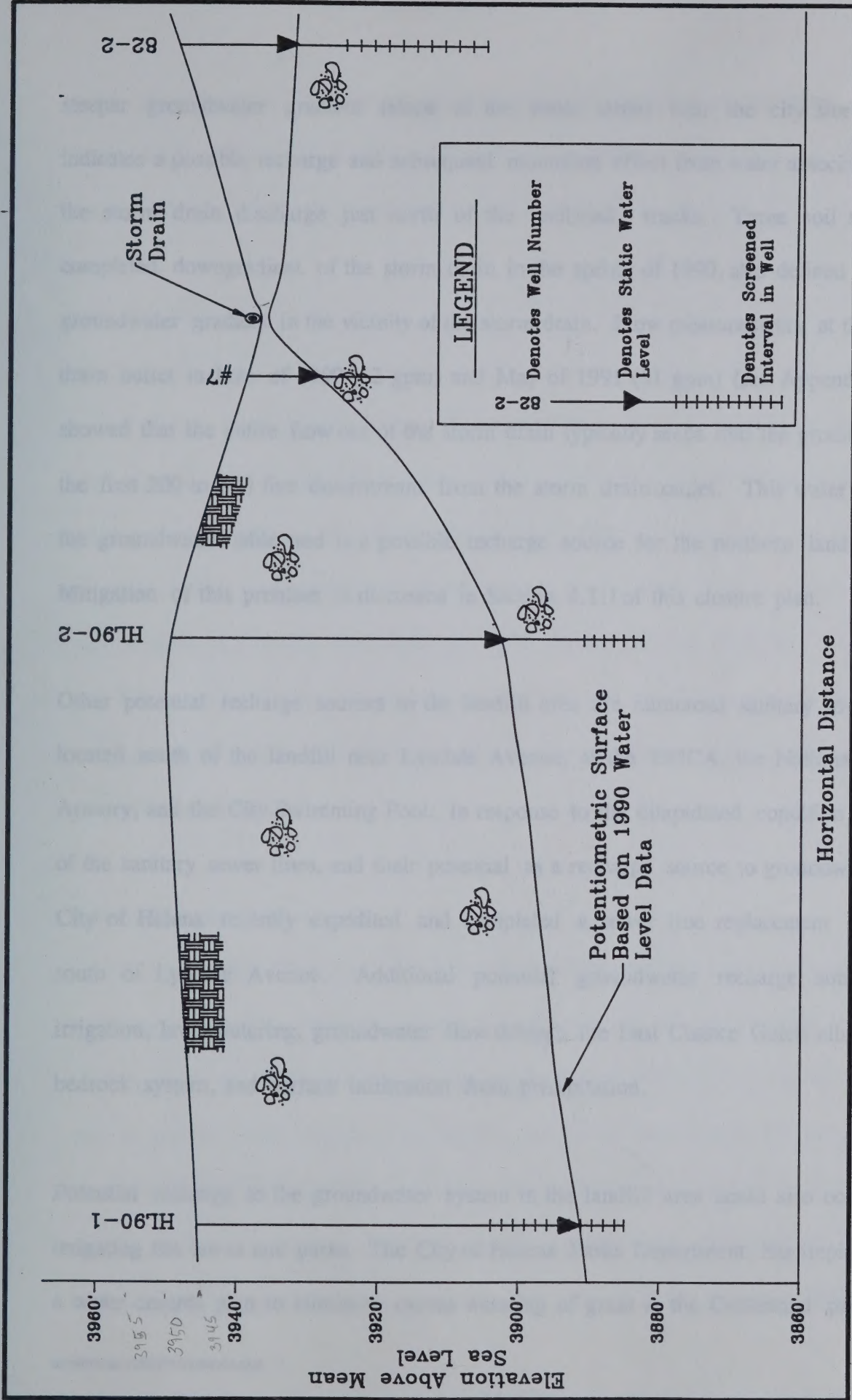


Figure 2.1: Hydrogeological Cross-Section Through Helena Landfill

Proj. No: CHHL01
 Dwg. No: HLF17-91
 Scale: AS NOTED
 Date:
 Rev Date: 4/9/93

Scale: Horizontal 1" = 300'
 Vertical 1" = 20'

steeper groundwater gradient (slope of the water table) near the city storm drain indicates a possible recharge and subsequent mounding effect from water associated with the storm drain discharge just north of the railroad tracks. Three soil test pits, completed downgradient of the storm drain in the spring of 1990, also defined a steep groundwater gradient in the vicinity of the storm drain. Flow measurements at the storm drain outlet in June of 1990 (52 gpm) and May of 1991 (81 gpm) (see Appendix A) showed that the entire flow out of the storm drain typically seeps into the ground within the first 200 to 300 feet downstream from the storm drain outlet. This water mounds the groundwater table and is a possible recharge source for the northern landfill area. Mitigation of this problem is discussed in Section 4.1.1 of this closure plan.

Other potential recharge sources to the landfill area are numerous sanitary sewer lines located south of the landfill near Lyndale Avenue, at the YMCA, the National Guard Armory, and the City Swimming Pool. In response to the dilapidated condition of some of the sanitary sewer lines, and their potential as a recharge source to groundwater, the City of Helena recently expedited and completed a sewer line replacement program south of Lyndale Avenue. Additional potential groundwater recharge sources are irrigation, lawn watering, groundwater flow through the Last Chance Gulch alluvial and bedrock system, and surface infiltration from precipitation.

Potential recharge to the groundwater system in the landfill area could also occur from irrigating the lawns and parks. The City of Helena Parks Department has implemented a water control plan to eliminate excess watering of grass at the Centennial park. The

water balance control plan involves evaporation and transpiration estimates using the Jensen-Haise (1963) ET method, soil moisture monitoring, estimating moisture input from rainfall and irrigation, and water system malfunction checks.

2.3 WATERQUALITY

Many groundwater and surface water quality samples have been obtained in the vicinity of the Helena landfill over the past 13 years. These samples have been analyzed for both organic and inorganic parameters. Most historic data are for inorganic parameters since earlier regulations did not require organic analysis. Appendix A is a compilation of water quality data obtained from the Helena landfill area. The raw laboratory data are included in Appendix B. Additional water quality data are available in EPA's 1987 and 1989 reports. These data are not included because the EPA results showed obvious quality control problems and the results are not considered representative of actual groundwater conditions.

Not that far back
6/90
No:
App B =
Strm Drain
Outfall Msmbr

2.3.1 Organic Water Quality

In 1987 and 1989, EPA investigated the Helena landfill site and concluded that site problems were not sufficiently severe to place the site on the National Priority List (NPL). However, EPA analytical results suggested that low levels of organic compounds may be present in the vicinity of the landfill. Additional sampling by Hydrometrics, Inc., in 1989 through Spring 1992 confirmed the presence of very low concentrations of volatile organic compounds (VOCs) beneath and peripheral to the landfill. Table 2.3 summarizes the types, chemical properties and uses of VOCs detected during these

TABLE 2.3: TYPICAL USES AND PROPERTIES OF THOSE
ORGANIC COMPOUNDS DETECTED IN GROUNDWATER - SPRING 1992

- 1) 1,1 Dichloroethane, or ethylidene chloride (CH_3CHCl_2), is a mobile liquid that is colorless and sparingly soluble in water. Some common uses are an extraction solvent and a fumigant.
- 2) Tetrachloroethane, or perchloroethylene ($\text{Cl}_2\text{C:CCl}_2$), is a stable, colorless liquid that is nearly insoluble in water. Some common uses are for dry cleaning and as a degreasing solvent.
- 3) 1,1,1 Trichloroethane, or methyl chloroform (CH_3CCl_3), is a colorless liquid, nearly insoluble in water. Common uses are metal degreasing, an ingredient in pesticides, textile processing and as a solvent for cleaning precision instruments.
- 4) Trichloroethene, or (tri), (CH:CCl_2), is a stable, photoreactive liquid slightly soluble in water. It is used as a metal degreaser, a diluent in paints, a refrigerant and for dry cleaning.
- 5) Chloroform (CHCl_3) is colorless and heavily reactive with a characteristic odor. It is used in analytical chemistry, as a solvent, as an expansion agent in styrofoam and as a fumigant.
- 6) Dichloromonofluoromethane, or Freon 21, (CHCl_2F) is a colorless, nearly odorless, heavy gas. It is used as a refrigerant and as a solvent.
- 7,8) Cis or Trans 1,2-Dichloroethene (ClHC:CHCl_2), is a colorless, low-boiling point liquid that exists in Cis and Trans isomers. It is slightly soluble in water and is used as a solvent, in lacquers, perfumes and thermoplastics.
- 9) 1,2 Dichloropropane, or propylene dichloride ($\text{CH}_3\text{CHClCH}_2\text{Cl}$), is a colorless stable liquid with a chloroform odor, nearly insoluble in water. It is used as a spotting agent, degreaser, soil fumigant for nematodes and a scouring compound.
- 10) Methylene chloride, or dichloromethane (CH_2Cl_2), is a colorless volatile liquid with an ether-like odor. It is slightly soluble in water and is used commonly for laboratory cleaning, a solvent for degreasing and a paint remover.
- 11) Dichlorodifluoromethane or fluorocarbon-12 (CCl_2F_2), is a colorless non-corrosive gas, nearly insoluble in water. Common uses are as a propellant and refrigerant.
- 12) Trichlorofluoromethane or fluorocarbon-11 (CCl_3F) is a colorless nearly odorless volatile liquid and is used as an aerosol propellant, solvent and in fire extinguishers.

Source: Sax and Lewis, 1987

sampling events. The analytical methods used to measure the concentration of VOCs in the groundwater were EPA Method 502.2, EPA Method 624, EPA Method 8260, and EPA Method 625.

Results of groundwater sampling and testing (Appendix A) showed VOCs are present in several wells. Table 2.4 shows the EPA maximum contaminant levels (MCLs) for each compound detected during the Spring 1992 sampling event as well as the highest concentration of the respective parameters detected in a domestic or irrigation well downgradient of the landfill. No EPA maximum contaminant levels (MCL) were exceeded in samples from domestic or irrigation wells during the Spring 1992 sampling event.

what about MCLs?

The following summarizes the results of organic analyses of groundwater samples from wells in the study area.

- 1) A total of 40 domestic, irrigation and monitoring wells northwest of the landfill area were sampled from 1989 to 1992 to determine water quality and 22 wells were surveyed to determine groundwater elevations. Based on this survey and a water level map, it has been determined that groundwater is generally flowing northwest from the landfill through sandy, silty, gravelly strata.

sample wells to North, too!

insufficient data

TABLE 2.4. VOLATILE ORGANIC COMPOUND LEVELS IN
PRIVATE WELLS NEAR HELENA LANDFILL

<u>Constituent</u>	<u>EPA Maximum Contaminant Level (MCL) Parts Per Billion (PPB)</u>	<u>Highest Concentration found in any private water well Parts per Billion (PPB)*</u>
Dichlorodifluoromethane	Not Listed	3.1
Trichlorofluoromethane	Not Listed	1.8
1,1-Dichloroethane	Not Listed	1.3
Total Trihalomethanes: Chloroform, Dibromomethane, Bromodichloromethane, Bromomethane	100.0 (for the sum of all)	<12.1
1,1,1-Trichloroethane	200.0	1.0
Tetrachloroethene	5.0	4.6
Trichloroethene	5.0	1.0

* Spring 1992 sampling event

- 2) Groundwater samples obtained from several domestic wells (potable supplies) were analyzed for volatile organic compounds (VOCs). Results of these analyses show the levels of all VOCs in Spring 1992 samples are lower than levels established by the EPA as maximum contaminant levels (MCLs) for listed priority compounds. A listed priority compound is a compound that EPA has identified because of its potential toxicological effects, and a maximum concentration has been set which should not be exceeded for drinking water.
- 3) Several VOCs were detected in irrigation wells northwest of the landfill. The concentrations of these compounds are very low (less than 10 parts per billion). No VOC concentration was above the EPA MCL for the irrigation wells tested in June 1992. Tetrachloroethane was detected in wells upgradient of the landfill as well as wells downgradient of the landfill. This indicates the landfill is likely not the only source of the tetrachloroethane.
- 4) Three VOCs, not listed by the EPA as priority compounds,* were detected in various wells. Because EPA does not consider ~~ed~~ these priority compounds, there has been no EPA maximum contaminant level established for these compounds. However, EPA has set maximum concentration limits for various known and suspected toxic and carcinogenic compounds at a level higher than the concentrations of these non-priority compounds detected near the landfill. It is anticipated that when EPA limits are established for these non-priority present

↑ will use SSI over bsgd.

compounds, these limits will be higher than the concentrations of the compounds in the tested wells.

Exhibit 2, shows the approximate lateral extent of selected organic compounds in the groundwater based on the Spring 1992 sampling event. Dichlorodifluoromethane was selected as the parameter to be plotted because of its relatively low retardation factor and because it is a common landfill contaminate. Dichlorodifluoromethane is a fluorocarbon used most extensively as an aerosol propellant for hair sprays, deodorants and many other household products. In addition, it is used as a refrigerant. The retardation coefficient for dichlorodifluoromethane in this alluvial system is approximately 1.6, or, groundwater can be expected to move 1.6 feet for every 1 foot dichlorodifluoromethane moves in the groundwater system. This difference in travel rates between groundwater and VOCs such as dichlorodifluoromethane is due to their affinity for soil particles (especially organic soil), and therefore the VOCs move at velocities less than the groundwater. Calculations for the retardation coefficient of dichlorodifluoromethane are shown in Table 2.5.

other compounds need to be mapped!
before you said "most mobile"?

In addition to retardation, other attenuation mechanisms decrease the concentration of organic compounds as they move through the groundwater away from the source of contamination. These mechanisms are dispersion or lateral spreading of the compound, and degradation (both chemical and by micro-organisms). It is difficult to determine exactly how much effect each of these attenuation mechanisms has on a solute because

TABLE 2.5 RETARDATION OF DICHLORODIFLUOROMETHANE

<u>Aquifer Characteristics</u>		
% Organic Carbon		=0.06 Calculated
% SOM		=0.10
Bulk density		=1.72 Calculated
Porosity		=0.35
<u>Chemical Compound</u>		
Dichlorodifluoromethane		
Solubility equation used was log Koc		=3.64 + .55 *
-Log 280		
Solubility		=0.28E + 03
mg/l		
Log Solubility		=2.45
(Solubility was entered into program as 280 mg/l)		
Koc		=0.20E + 03
Log Koc		=2.29
Retardation Coefficient		=1.6
Rf value		=0.6403
Solubility equivalents based on molecular weight of 120.92		
<u>mg/l</u>	<u>micromoles/l</u>	<u>mole fraction</u>
0.2800E + 03	0.2316E + 04	0.4171E -04
Logs of above solubilities		
2.4472	3.3647	-4.3797

Source: Oklahoma State University, Dr. Hanslow, 1988.

many factors such as solute concentration, aquifer characteristics, and geochemical factors are involved.

A sanitary landfill has a relatively simple mechanism of leachate production. In general, water percolates into, or is initially present in landfill refuse and creates a solute or a leachate. Residual water and chemicals present during landfilling could include partially filled containers of paint, lacquer, cleaning fluids, aerosols, plastics, organic products and free liquid chemicals. Containers either break and release the chemicals immediately, or slowly rust and release the chemicals over time. Additional landfilled chemicals could include pesticides, fumigants, fuels, oils and many others (Sax and Lewis, 1987).

Some of the chemical compounds commonly found in landfill leachate are dichlorodifluoromethane, trichlorofluoromethane, trichloroethane, 1-2-dichloroethene, methylene chloride, and tetrachloroethane. Dichlorodifluoromethane and trichlorofluoromethane were commonly used as aerosol propellants* (Table 2.3). 1-2-Dichloroethene (both in cis and trans isomers) is commonly used as a household lacquer and trichloroethene is commonly used to dilute paint. Methylene chloride is commonly used as a paint remover. Tetrachloroethane is used in dry cleaning and as a degreasing solvent. The production of tetrachloroethane alone exceeded 300 thousand tons per year in the United States in 1982 (Moore and Ramamoorthy, 1984).

In addition to landfill leachate generation, additional sources of organic compounds

present in the groundwater in the vicinity of the landfill are likely. Irrigation wells near the landfill were sampled and showed low levels of tetrachloroethane and chloroform. These include wells 28, 34 and 24 (see Exhibit 1). A source of organic contaminants upgradient of these wells is likely adding to the low levels of organic compounds in the groundwater. The source of these compounds is unknown, however, dry cleaners, service stations or other industrial facilities in the Euclid Avenue area could be the potential source of the low levels of tetrachloroethane. Chloroform (and the low levels of other trihalomethanes) in the groundwater could be in part the result of lawn watering with City of Helena water or leaky sanitary sewer lines. Analysis showed concentrations of trihalomethanes in three city water samples below the EPA MCL, but were in the 90 parts per billion range, which is well above any concentrations found in the groundwater. In addition to trihalomethanes in city water, chlorinated water discharged in sanitary sewers from the YMCA and city pool could seep into the groundwater and create chloroform. Humic and fulvic acids (commonly present in organic soils) have the required structural and functional arrangements for a haloform reaction (Moore and Ramamoorthy, 1984). Sanitary sewer pipes from the city pool are designated by the City as class 2 pipelines. The classification system ranges from Class 1, sewage pipes that are heavily dilapidated, to class 5, sewage pipes that have been recently replaced. As discussed in Section 2.2, the city storm drain is likely creating a groundwater mound in the landfill area. A portion of this groundwater could be percolating through refuse, and it also may initially contain organic compounds from the storm drainage area which is Last Chance Gulch. Samples of this storm drain water obtained previously by EPA showed low levels of VOCs.

Generally, storm drainage is poor in quality because it contains street runoff which significantly degrades water. In addition, there could possibly be illegal discharges into city drains. Sanitary sewer pipes upgradient of monitoring well HL-1 are in poor condition and are designated by the City as class 1 pipes. These pipes were installed in the late 1800s and are dilapidated. A water sample obtained from monitoring well HL-1 and analyzed for coliform bacteria (a bacteria present in the feces of warm blooded animals) showed significant contamination. Because of this problem, these dilapidated pipes were placed on an expedited replacement plan by the City.

2.3.2 Inorganic Water Quality

Inorganic water quality beneath and peripheral to the Helena landfill (Appendix B) also indicates a plume is present. Chloride concentrations and specific conductivity are elevated in the landfill vicinity and decrease in concentration downgradient of the landfill. The total dissolved solids concentration in groundwater in the landfill vicinity (Appendix B) is slightly higher than the secondary drinking water standard of 500 mg/l. Nitrate plus nitrite is present in groundwater in several wells and has historically exceeded 10 mg/l in monitoring wells completed in the landfill (Appendix B). Concentrations of other major minerals appear to be elevated in the vicinity of the landfill. These elevated levels are likely due to the landfill as well as other upgradient sources. Concentrations of dissolved metals in the groundwater show no apparent water quality change in the vicinity of or downgradient of the landfill.

3.0 COVER SOIL

The type of soil used for covering landfill refuse is very important in controlling landfill leachate. The cover soil used for the City of Helena Landfill closure meets all requirements set forth by the State of Montana (ARM Title 16, Chapter 14, Subchapter 5, Section 16.14.521(2), and the MDHES document of April 3, 1991, entitled "Class II Landfill Closure Requirements and Recommendations" as well as the Subtitle D requirements for cover soil as presented in 40 CFR Part 258, Section 258.60. The cover will consist of two layers as specified in Subtitle D. These two layers are the infiltration layer and the erosion layer. The infiltration layer is discussed in the following section, and the erosion layer will be discussed with the vegetation plan in Section 4.2.

3.1 SOURCES AND PHYSICAL CHARACTERISTICS OF THE INFILTRATION LAYER COVER SOIL

Two cover soil sources are being utilized in the final cover infiltration layer for the City of Helena Landfill. These two sources are the Walmart construction site east of town and the "Site E" proposed landfill site about 10 miles northeast of town. These sources and the physical characteristics of the soils utilized from each source are discussed in the following sections.

3.1.1 Walmart Construction Site Soil

The cover soils borrowed from the Walmart Construction Site east of Helena generally

consist of sandy clays with occasional gravels. These soils were borrowed on a selective basis with the more clayey soils used for cover material. A composite sample of this material was collected and submitted to the Braun Intertec Laboratory in Billings for standard proctor and permeability testing. This material was classified by the laboratory as a sandy lean clay with gravel. The standard proctor test determined that the maximum dry density of the soil was 112.5 pounds per cubic foot (pcf). A portion of the submitted material was remolded to a density of 103.4 pcf (approximately 90% of standard proctor maximum density) and both constant and falling head permeability tests according to ASTM D 5084 were run on the soils. The resultant calculated permeabilities from these tests ranged from 4.1×10^{-7} cm/sec to 4.2×10^{-7} cm/sec (Appendix C). These calculated permeabilities were well below the Subtitle D criteria of 1×10^{-5} cm/sec. The permeability of the cover soil will be verified in the field by performing nuclear gage testing of the in-place density of the material and other methods as detailed in Section 3.2. The 90% standard proctor density which was used for the permeability testing in the laboratory should be easily obtainable in the field.

3.1.2 "Site E" Soil

The cover soil material borrowed from the "Site E" proposed landfill site has been extensively studied during the permitting process for the new proposed City/County landfill. This soil typically ranges from sandy clays to clayey sands. Several in-situ and ex-situ hydraulic conductivity and permeability tests were performed on these soils as part of the permitting process. Three "pump-in" tests (Appendix C) that were performed in test pits in these soils are described in the permit application. These three tests

revealed hydraulic conductivities of the soils in-place ranging from 1.2×10^{-7} cm/sec to 6.8×10^{-7} cm/sec (Appendix C). In addition, two triaxial permeability tests were performed on two samples of this material according to the Army Corp of Engineers Manual Method EM 110-2-1906, Appendix VII. These test resulted in calculated permeabilities of these soils ranging from 1×10^{-7} cm/sec to 2×10^{-8} cm/sec (Appendix C). These soils exhibit permeabilities far below the 1×10^{-5} cm/sec criteria established by the EPA in the Subtitle D regulations.

3.2 INFILTRATION LAYER SOIL REQUIREMENTS AND QUALITY CONTROL

Montana Administrative Rule ARM 16.14.521 and the MDHES document of April 3, 1991 require that at least two feet of cover soil with a permeability of less than 1×10^{-3} cm/sec be applied over all areas which have received landfill materials. In addition, the Subtitle D requires that all landfill areas that receive wastes on or after October 9, 1991, shall be covered with 18 inches of cover soil that is of equal or less permeability as the soils underlying the landfill, or having a permeability of 1×10^{-5} cm/sec or less, whichever is less. These requirements will be ensured by the following methods.

1. Double Ring Infiltration Tests - Double ring infiltration tests will be performed on cover soils to determine in-place infiltration rates after they are compacted in place. Approximately eight to ten double ring infiltration tests will be performed on the cover soil in place.
2. Nuclear Gage Density Tests - Soil density will be measured with a nuclear gage

each time a double ring infiltration test is performed. This will allow a correlation between soil density and infiltration rates. In addition, soil density will be measured on approximately a 200 foot grid basis.

3. Laboratory Remolded or Shelby Tube Permeability Tests - Approximately 3 to 5 samples will be tested by a professional laboratory. The number of samples will be based on the material being used for the cover soil.

The depth of all in-place cover soil will be verified by inspections by a city engineer. All grades will be staked by the engineer prior to placement of the soils, and cover soil placement activities will be documented and approved by the engineer.

4.0 FINAL COVER DESIGN

The final cover for the City of Helena Landfill has been designed as per the State of Montana Class II Landfill Closure Requirements and Recommendations (April 3, 1991) and Subtitle D cover design criteria. Proposed future land use, maintenance and monitoring have all been considered in the final cover design.

4.1 DRAINAGE - RUNON/RUNOFF PLAN

Exhibit 3 shows the final grading and drainage plan for the completed cover on the Helena Landfill. This plan allows precipitation to runoff quickly and efficiently away from all areas which contain buried refuse. The cover topography of the landfill, and the drainage ditch system peripheral to the landfill were designed to eliminate surface runoff. Runoff from the Last Chance Gulch area, however, drains under the landfill in the city storm drain running below the landfill. To eliminate potential recharge to the landfill from this source, the drain will be extended to discharge further away from the landfilled areas. This extension is detailed in Section 4.1.1 of this closure plan.

This drainage plan considers the drainage plan designed by Damschen and Associates for the proposed transfer station which may be located at the present landfill site. This is contingent on the City's selected waste disposal alternative for after the present landfill no longer accepts waste.

4.1.1 Extension of the City Storm Drain

Springtime flows for the Last Chance Gulch area storm drain outfall located just north of the landfill were measured in 1990 and 1991. These flow measurements are shown in Appendix A. Flows from the outfall ranged from 52 gallons per minute (gpm) to 81 gpm and all flow typically percolates into the ground within the first 200 feet of the channel below the outfall. This channel is excavated to the north of the landfill along the east side of Bill Roberts Golf Course. The water which seeps into the ground causes a mounding effect on the local water table that could potentially saturate refuse or recharge the aquifer with poor quality storm runoff water.

Figure 4.1 is a cross-section which shows the mounded water table (under high water table conditions) and its relationship to the landfill cell area. This cross-section suggests that the northwest corner of the landfill cell number 18 has the highest potential to be impacted by the mounded water table. It is important to note that several assumptions have been made in the preparation of this cross-section. These assumptions are outlined as follows:

1. That the outfall from the storm drain is essentially a point recharge to the groundwater system. This requires that the storm drain running beneath the landfill is competent and that no leakage occurs. The storm drain was inspected by city workers in 1990 (personal communication, Dick Nisbet, May 1991) and no leakage was observed in the concrete section above the location of the outfall near the northern most railroad track (Exhibit 1).

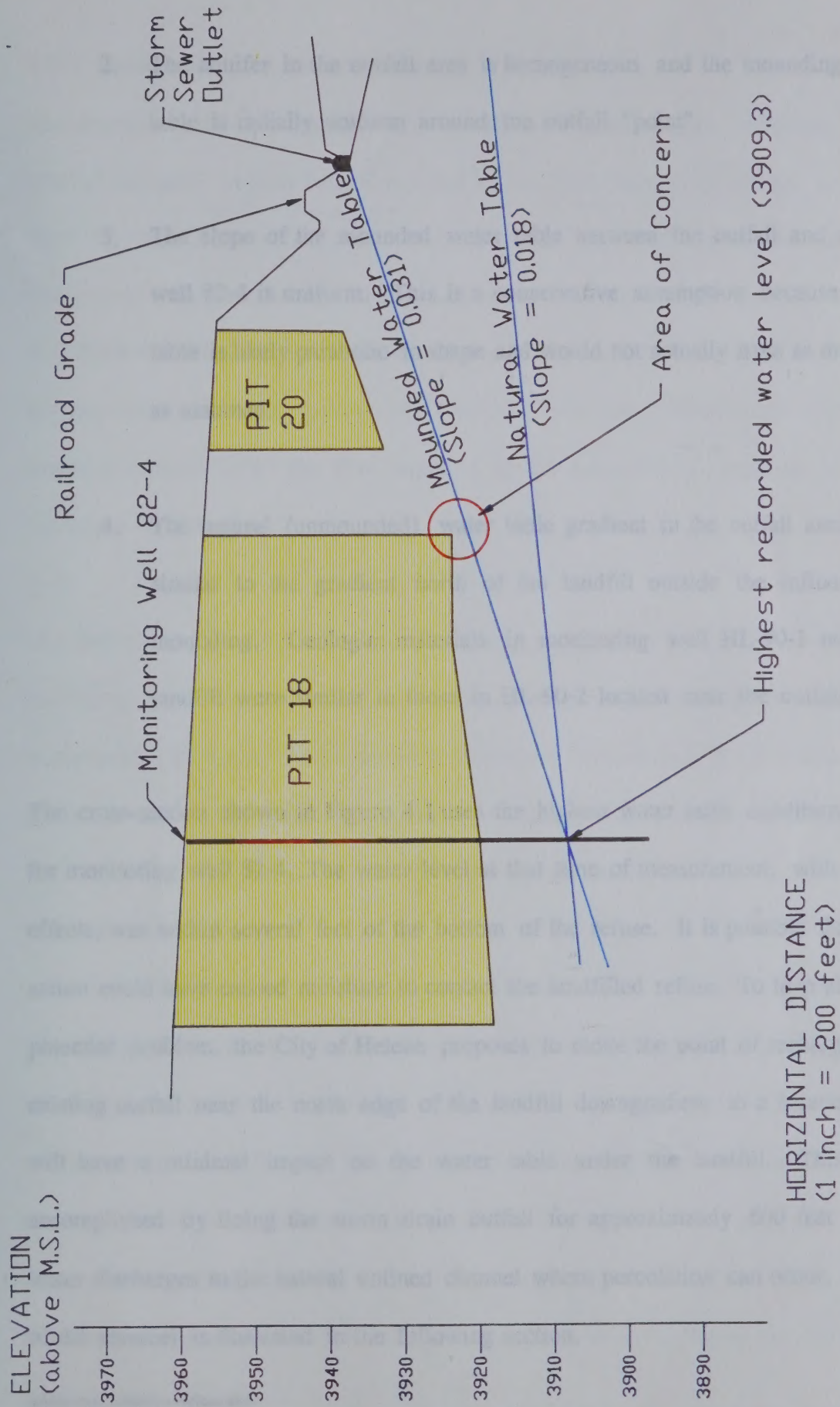


Figure 4.1: Cross-Section of Storm Sewer Outfall Area

Proj. No: CHHL01

Dwg. No: HLF17-91

Scale: AS NOTED

Date:

Rev Date: 4/9/93

2. The aquifer in the outfall area is homogeneous and the mounding the water table is radially uniform around the outfall "point".
3. The slope of the mounded water table between the outfall and monitoring well 82-4 is uniform. This is a conservative assumption because the water table is likely parabolic in shape and would not actually have as much impact as assumed.
4. The natural (unmounded) water table gradient in the outfall area would be similar to the gradient north of the landfill outside the influence of the mounding. Geologic materials in monitoring well HL-90-1 north of the landfill were similar to those in HL-90-2 located near the outfall.

The cross-section shown in Figure 4.1 uses the highest water table condition on record for monitoring well 82-4. The water level at that time of measurement, with mounding effects, was within several feet of the bottom of the refuse. It is possible that capillary action could have caused moisture to contact the landfilled refuse. To help alleviate this potential problem, the City of Helena proposes to move the point of recharge from the existing outfall near the north edge of the landfill downgradient to a location where it will have a minimal impact on the water table under the landfill. This would be accomplished by lining the storm drain outfall for approximately 600 feet before the water discharges to the natural unlined channel where percolation can occur. The design of the channel is discussed in the following section.

4.1.2 Design of Storm Drain Extension

The channel extension consists of a two-phase channel design, including a low-flow channel designed to pass base flows and an artificial flood-plain terrace to pass flood flow. The base flow portion of the channel will be lined with a synthetic liner material. The overall length of the new section of channel is approximately 500 feet with a slope of 0.015 ft/ft. The estimated base or low design flow is approximately 0.5 cfs (cubic feet per second) or 225 gpm (gallons per minute). The design flood flow value is 391 cfs which is derived from the flow capacity of the immediately upstream culvert that discharges to the new channel.

The low-flow section of channel is triangular in shape, has a maximum flow depth of 0.5 feet, 10 to 1 side slopes and has a top width of 10 feet. The artificial flood-plain section is trapezoidal in shape, has a maximum flow depth of 2.95 feet, 2.5 to 1 side slopes and has a top width of 24.8 feet. Riprap will be used in both channel phases and will have a d^{50} of 8.3 inches. The maximum riprap diameter is 12.5 inches and the riprap layer thickness is 18 inches.

The Manning's roughness coefficients used for the channel design was increased by 10% to allow for suspended material and debris, plus increased bedload volumes accompanying flood flows. This in effect calls for a deeper channel, thus ensuring containment of flood flows. A design safety factor of 1.5 was applied for channel freeboard. The design freeboard is 0.5 feet, bringing the total channel depth to 3.95 feet with a total top width of 29.8 feet. Flow regimes in both phases are subcritical. A

schematic of the two-phase channel design is shown on Figure 4.2 and the calculations are shown in Table 4.1. The new channel is designed to extend 390 feet from the existing concrete bulkhead under the railroad track. The final design of the channel will be performed by the City of Helena Engineering Department.

After completion of the new storm drain extension, water levels in peripheral monitoring wells and piezometers will be carefully monitored to assess the impacts of the storm drain extension.

4.2 EROSION LAYER AND VEGETATIVE COVER

Subtitle D regulations require that at least six inches of topsoil be placed above the infiltration layer soil to protect the cover from erosion and desiccation. The regulations also specify that this soil be capable of sustaining "native vegetation". This topsoil layer for the Helena Landfill will be from the "Site E" borrow source located to the north of the City. The soil consists of clayey sand, to sandy clay and is referred to by the Soil Conservation Service (SCS) as the Weingart Assiniboine Complex. These soils will be borrowed and segregated on a selective basis and the coarser materials more suited to sustaining vegetation will be used for the erosion layer. According to SCS data (included in Appendix D the texture, pH, salinity, organic matter content appear adequate to sustain vegetation with proper fertilization. The current landuses for these soil types according to the SCS are as non-irrigated and irrigated crop land. Crops currently grown on these soils include spring wheat, winter wheat, barley, alfalfa hay, grass legume hay, and native pasture. In addition, the City will have a fertility test run on the soil to

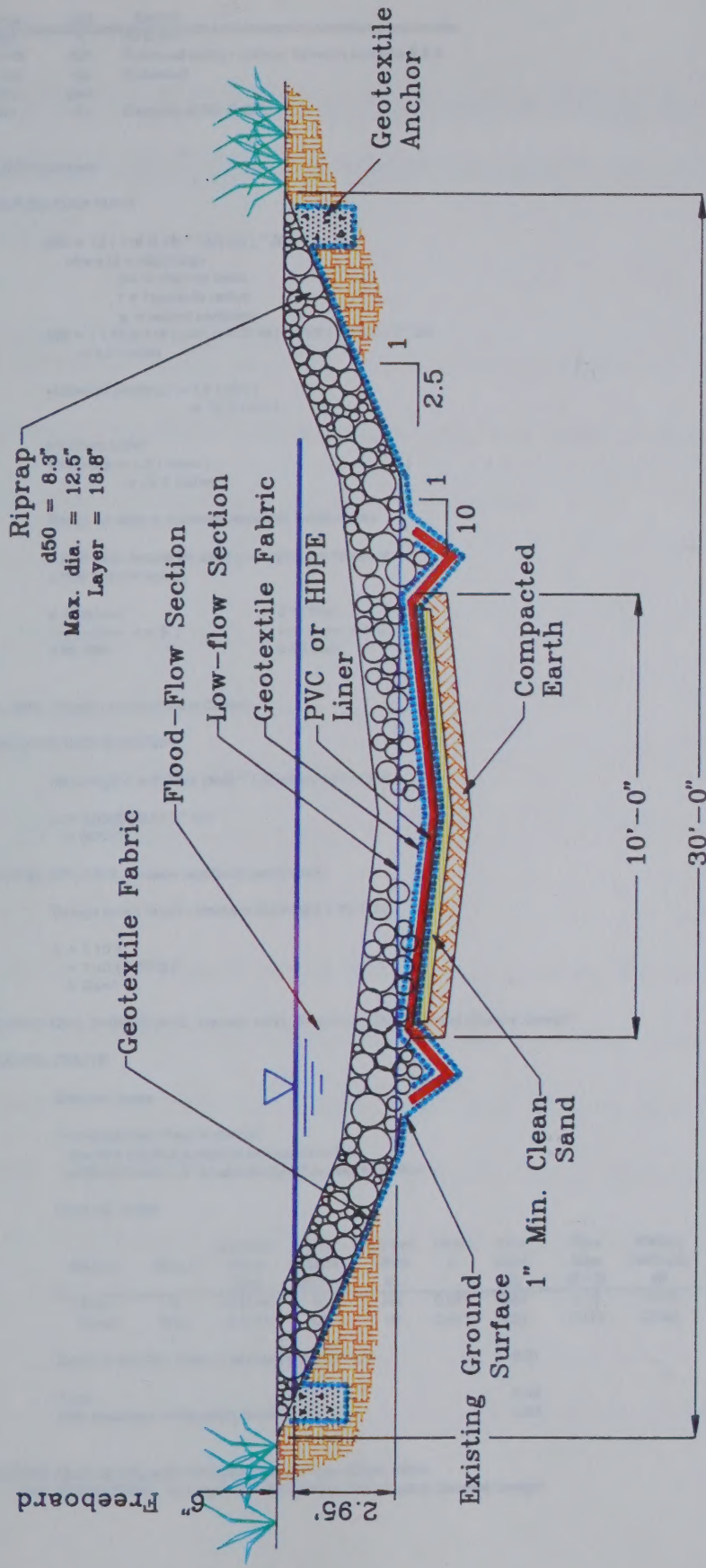


Figure 4.2:
Storm Sewer Extension Cross-Section

Proj. No: CHHL01
 Dwg. No: HLF2592S
 Scale: NOT TO SCALE
 Date: 3/23/93
 Rev Date: 4/9/93

Parameters	Value	Unit	Source
Length of channel	430	ft	Air photo
channel	0.0148	ft/ft	Bulkhead outlet - midway between sections 8 & 9
base flow	0.446	cfs	Estimated
	200	gpm	
100 year flood flow	391	cfs	Capacity of 60" R.C.P.

Channel Capacity Calculations

I. RIPRAP CALCULATIONS

- $d_{50} = 12 \left(\frac{118 Q S_b}{r^3} \right)^{2/5}$
 where Q = discharge
 S_b = channel slope
 r = Hydraulic radius
 p = wetted perimeter
 $d_{50} = \left[\left(\frac{12}{118} \right) \left(\frac{391}{0.0148} \right)^{2/5} \right]^{2/5}$
 $= 8.3$ inches

- Maximum diameter = 1.5 (d_{50})
= 12.5 inches

- Minimum Layer
Thickness = 1.5 (d_{max})
= 18.8 inches

- Riprap up side to maximum expected depth of flow

- A filter cloth should be used underlying the riprap, or a filter blanket using:

$$\frac{d_{15 \text{ riprap}}}{d_{85 \text{ filter}}} \leq 5 ; \quad \frac{d_{15 \text{ filter}}}{d_{85 \text{ base}}} \leq 5$$

SOURCE: EPA, 1976. Erosion and Sediment Control.

II. MANNING'S N CALCULATION

- Manning's $n = 0.0395 (d_{50})^{1/6}$, where d_{50} in feet
 $n = 0.0395 (0.67)^{1/6}$
 $= 0.0372$

SOURCE: EPA, 1976. Erosion and Sediment Control.

- Design safety factor - increase Manning's n by 10%

$$n = 1.10 n$$

$$= 1.10 (0.0372)$$

$$= 0.041$$

SOURCE: CIVIL ENGINEERING, January 1990. "Rethinking Flood-Control Channel Design".

III. CHANNEL DESIGN

- Channel shape

Two-stage flow-channel design:

- low-flow channel designed to pass base flow
- artificial flood-plain terrace designed to pass flood flow

- Channel Design

Section	Shape	Channel Slope (ft/ft)	Side Slope (H:1V)	Bottom Width (ft)	Mannl n	Flow depth (ft)	Flow Area (ft ²)	Wetted Perimeter (ft)	Calc Flow (cfs)	Top Width (ft)	Avg Velocity (fps)	Froude Number
Base	Tri	0.0148	10	NA	0.041	0.50	2.50	10.05	4.37	10.0	1.7	0.62
Flood	Trap	0.0148	2.5	10	0.041	2.95	53.76	25.94	386.35	24.8	7.2	0.88

Depth in low-flow channel at design low-flow $q =$ 0.21Total 3.45
With freeboard using safety factor = 1.5 3.95390.72 24.8
29.8

SOURCE: Manning's Equation for Open Channel Flow. Chow, 1964.

CIVIL ENGINEERING, January 1990. "Rethinking Flood-Control Channel Design".

determine a proper fertilization rate to maximize the soil's fertility. Based on this test, a fertilization rate will be recommended by a qualified soil scientist and implemented by the City.

Based on conversations with the SCS and recommendations from Nate Halubka, who has extensive experience with reseeding reclaimed areas as an employee with Grasslands, Inc., the following seed mix per acre is suggested:

- 5 lbs fairway crested wheatgrass

- 5 lbs durar hard fescue

- 2.5 lbs slender wheatgrass

- 3.5 lbs Canada wheatgrass

This seed mixture is based on the drill seeding method, if broadcast seeding is required, the seed mixture will have to be doubled. This vegetation plan is also contingent on the final usage for the reclaimed landfill site. Any changes in the vegetation plan will be submitted to the MDHES for approval before being implemented. Potential future usage of the reclaimed landfill is discussed in Section 7.0 of this closure plan.

5.0 CLOSURE CERTIFICATION

Prior to final closure of the Helena Landfill, the City of Helena will notify users via public announcement, and an alternative disposal facility will be named. This alternative disposal facility has not been officially selected at this time. This closure plan will also be made available for public inspection. Access will be restricted to all areas to prevent refuse disposal and cover damage unless future landuse activities are proposed by the City of Helena and approved by MDHES. Access will only be allowed to the transfer station once it becomes operational. The MDHES will be notified immediately when the City of Helena will no longer accept waste. After final closure activities are complete, the MDHES will be sent documentation that closure has been completed according to the approved closure plan. This documentation will be certified by a professional engineer.

The landfill closure shall be considered an "interim closure" until it is approved in writing by a solid waste program inspector from the Solid and Hazardous Waste Bureau of the Montana Department of Health and Environmental Sciences. When such notice is given, the landfill will be declared officially closed and the City of Helena shall surrender their Solid Waste Management System License for this site to the MDHES. The time schedule for the final closure activities is dependent on the selected disposal alternative however, the Helena Landfill does not anticipate accepting waste on or after October 9, 1993.

6.0 POST CLOSURE MAINTENANCE AND MONITORING

Post closure maintenance and monitoring are necessary to ensure the long term integrity of the landfill cover. This post closure maintenance and monitoring plan fulfills the requirements set forth by the State of Montana's Class II Landfill Closure Requirements and Recommendations (April 3, 1991).

6.1 VISUAL INSPECTION - EROSION, SETTling AND VEGETATION CONTROL

The landfill cover and drainage ditch system will be inspected annually (the annual inspection will occur in late spring) and after major rain events to determine its integrity. The inspection will consist of checking for erosion, differential settling, and washing out of vegetation. Rills forming in the cover will be repaired to original grade and reseeded. Erosion controls such as geofabrics, straw dams, etc. may be implemented to control problem areas.

The cover will also be inspected for extensive differential settling. Differential settling could potentially result in ponded areas on the landfill cover, resulting in leachate production. Problem areas will be regraded to original grade and reseeded.

Drainage ditches will also be maintained after the landfill is closed. Ditches will be inspected during the routine annual inspection for blockage or excessive erosion and erosion will be controlled with riprap, liners, or other acceptable measures. Culverts will be cleaned when necessary to maintain proper flow in the ditches.

Repairs to the landfill cover and ditches will be performed as soon as possible after problems are discovered to avoid major damage to the cover. Small problems such as erosional rills and washed out vegetation can be handled very quickly, whereas larger problems may require more investigation and design to mitigate.

This visual inspection portion of the post-closure maintenance and monitoring plan will be ongoing until such time as the MDHES deems necessary to ensure that conditions are stable and potential for problems is minimized.

6.2 GROUNDWATER MONITORING

This post-closure groundwater monitoring plan fulfills the requirements as set forth by the State of Montana Administrative Rules, Title 16, Chapter 14, Sub-Chapter 7 - Proposed Groundwater Monitoring Rules For Landfills in Montana, and the Montana Class II Landfill Closure Requirements and Recommendations (April 3, 1991).

Groundwater sampling and reporting will be performed by or under the direction of the recently established City/County water quality district.

The proposed water quality sampling schedule for the City of Helena Landfill (Table 6.1) incorporates the comments of the MDHES and the City/County Health Department. Parameters that would be analyzed are in the analytical schedule on Table 6.2. The parameter list is based on the landfill groundwater monitoring requirements developed by MDHES.

Will use monitoring as closure is achieved to 10/9/93

TABLE 6.1 WATER QUALITY ANALYTICAL SCHEDULE

<u>Well Number</u>	<u>Analysis</u>	<u>Date</u>
✓ 83-6	Phase I Parameters	Spring, Fall
✓ HL90-1	Phase I Parameters	Spring, Fall
✓ HL90-2	Phase I Parameters	Spring, Fall
✓ HL90-3	Phase I Parameters	Spring, Fall
✓ 40	Phase I VOCs	Spring, Fall
✓ 31	Phase I VOCs	Spring, Fall
5	Phase I VOCs	Spring, Fall
✓ 13	Phase I VOCs	Spring, Fall
✓ 75	Phase I VOCs	Spring, Fall
✓ EPA-1	Phase I VOCs	Spring, Fall
✓ 59	Phase I VOCs	Spring, Fall
✓ 52	Phase I VOCs	Spring, Fall

? AB Custer Ave, Wolf Benton

Note: Because private well are sometimes difficult to access, nearby wells may be substituted, if necessary.

TABLE 6.2 GROUNDWATER MONITORING PARAMETERS

- | | |
|-----------------------------------|----------------------------|
| 1. Ammonia (as N) | 14. Total Dissolved Solids |
| 2. Bicarbonate (HCO_3) | 15. Total Suspended Solids |
| 3. Calcium | 16. Specific Conductance |
| 4. Carbonate | 17. pH |
| 5. Chloride | 18. Arsenic |
| 6. Iron | 19. Barium |
| 7. Magnesium | 20. Cadmium |
| 8. Manganese, dissolved | 21. Chromium |
| 9. Nitrate (as N) | 22. Cyanide |
| 10. Potassium | 23. Lead |
| 11. Sodium | 24. Mercury |
| 12. Sulfate (SO_4) | 25. Selenium |
| 13. Chemical Oxygen Demand (COD) | 26. Silver |

27. The following volatile organic compounds (VOCs by EPA Method ⁸²⁶⁰8240):

- | | |
|-----------------------------|-----------------------------|
| ◦ Benzene | ◦ Dichlorodifluoromethane |
| ◦ Bromochloromethane | ◦ 1,1-Dichloroethane |
| ◦ Bromodichloromethane | ◦ 1,2-Dichloroethane |
| ◦ cis-1,3-Dichloropropene | ◦ Iodomethane |
| ◦ Trans-1,3-Dichloropropene | ◦ Methylene chloride |
| ◦ 1,4-Difluorobenzene | ◦ 1,1-Dichloroethene |
| ◦ Ethylbenzene | ◦ trans-1,2-Dichloroethane |
| ◦ Ethyl methacrylate | ◦ Styrene |
| ◦ 4-Bromofluorobenzene | ◦ 1,1,2,2-Tetrachloroethane |
| ◦ Bromoform | ◦ Toluene |
| ◦ Bromomethane | ◦ 1,1,1-Trichloroethane |
| ◦ Carbon tetrachloride | ◦ 1,1,2-Trichloroethane |
| ◦ Chlorobenzene | ◦ Trichloroethene |
| ◦ Chlorodibromomethane | ◦ Trichlorofluoromethane |
| ◦ Chloroethane | ◦ 1,2,3-Trichloropropane |
| ◦ 2-Chloroethyl vinyl ether | ◦ Vinyl acetate |
| ◦ Chloroform | ◦ Vinyl chloride |
| ◦ Chloromethane | ◦ Xylene |
| ◦ Dibromomethane | |

Tetrachloroethene (PCE)

NOTE: Phase I parameters include all parameters listed above.
Phase I VOC's include parameters listed in item number 27.

TABLE 6.3: SUMMARY OF METHANE MONITORING SITES

All samples will be obtained using documented and accepted sampling techniques. One duplicate and one blank sample will be obtained and analyzed per sampling event for quality control and quality assurance. Monitoring results will be submitted to the MDHES and City/County Health Department by the water quality district when the results are obtained and validated.

6.3 METHANE MONITORING

Methane monitoring in the vicinity of the Helena Landfill has been performed since the early 1980's. Early monitoring consisted of combustible gas surveys in monitoring wells HL-1 through HL-7 and the basements of the YMCA and State Armory Buildings. During this time the highest concentrations of methane were observed in well HL-4 and range from 2.2 to 6.4% (personal communication, Fritz Zettal, City of Helena Fire Department, January 1990). Results of recent methane monitoring at the Helena Landfill are discussed in the "Helena Landfill 1992 Annual Report on Groundwater and Methane Monitoring" which was submitted to MDHES in August 1992.

At the request of MDHES, a new program encompassing the northern part of the landfill area was implemented in Spring 1991 and this program was expanded in 1992 at the request of the MDHES. The present methane monitoring program includes quarterly monitoring of 14 monitoring wells and 5 structures as shown on Table 6.3. This program was approved by the MDHES in a November 1991 letter to the City. The MDHES did however, suggest that several dedicated methane monitoring probes be installed to increase the monitoring around the periphery of the landfill.

TABLE 6.3: SUMMARY OF METHANE MONITORING SITES

LOCATION	SITE CONDITIONS
MPC Office (In basement)	Office Basement
YMCA (In sub-basement)	In building's sub-basement
Armory (In basement)	In basement of armory building
82-3*	Adjacent to Helena Landfill shop
HL90-3*	SW edge of present active landfill
HL90-1*	NW of present active landfill
HL90-2*	North of present active landfill
82-2*	NE edge of present active landfill
EPA-1*	NE edge of Phase I landfill
83-7*	North edge of Phase I landfill
EPA-4*	North edge of Phase II landfill
HLP91-1*	North of present active landfill
Elk River Concrete Shop	West of present active landfill
Landfill Office (at scalehouse)	In present Scalehouse Building
Landfill Shop	In present Shop Building
HL-1*	South of Phase I landfill
HL-7*	North of present active landfill
I-5*	West of present active landfill
I-6*	NW edge of Phase II landfill
EPA-2*	North of YMCA building
Calibration Standard (typically 100 ppm methane)	In Phase I landfill 100 ppm methane calibration standard
***PROPOSED METHANE MONITORING PROBES AS SHOWN ON FIGURE 6.1	Peripheral to all landfilled areas as shown on Figure 6.1

* Groundwater monitoring well or piezometer

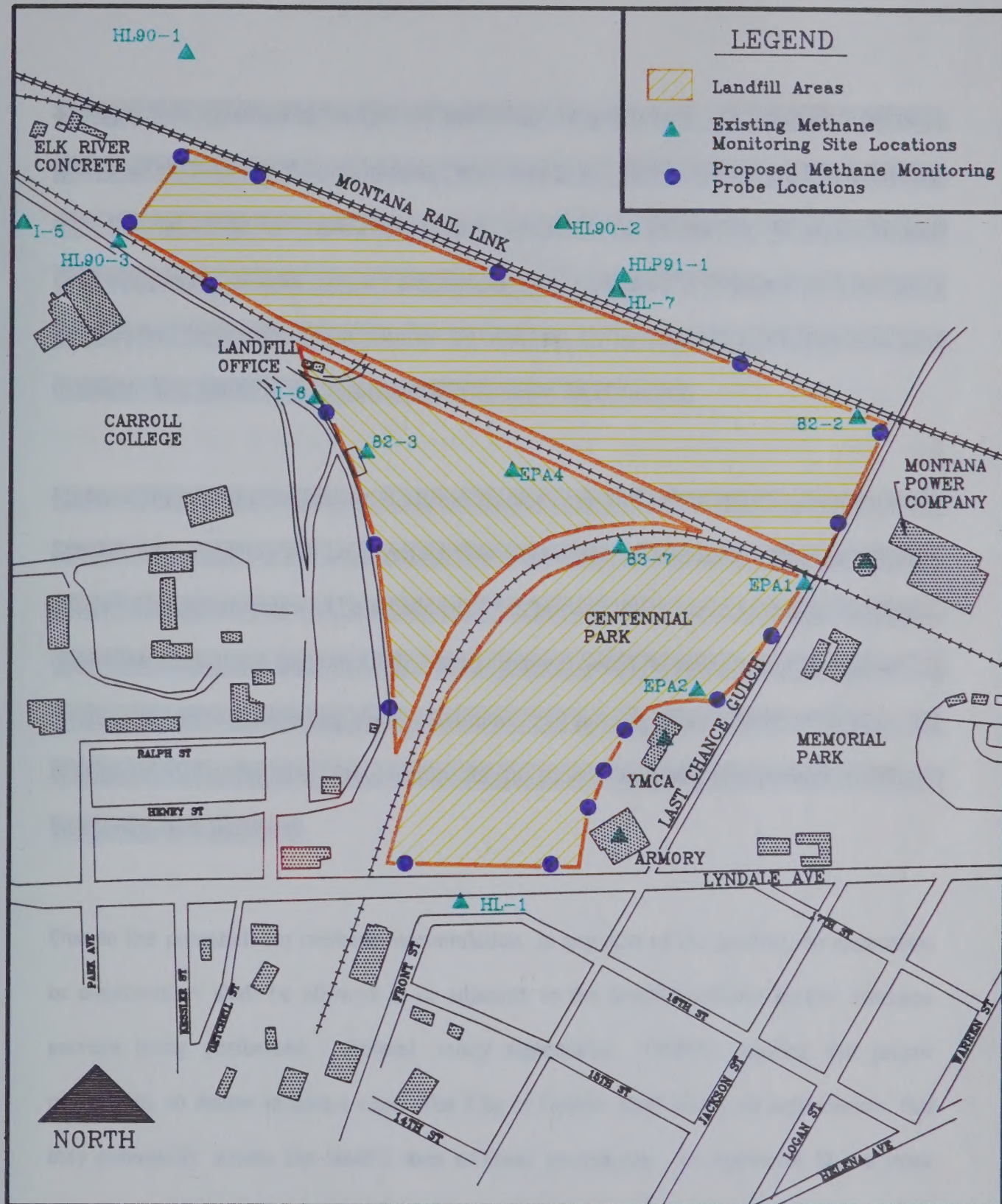
*** Proposed monitoring probe locations as shown on Figure 6.1

NOTE: All methane monitoring site locations are shown on Figure 6.1

In response to the MDHES' request, the City has revised the present methane monitoring program to include all of the present monitoring locations as well as the proposed new methane monitoring probes as shown on Figure 6.1. These probe locations were chosen based on the location of present monitoring locations and the proximity of inhabited dwellings. Probe spacing is denser near inhabitable dwellings.

The new methane monitoring probes will be installed after probe locations presented in this document are approved by the MDHES. The probes will be installed by drilling a bore hole (hole depth will be based on the depth of garbage within a 500 foot radius of the probe location) and placing a perforated or slotted 1/2 inc PVC pipe into the hole. The bottom 4 to 5 feet of the pipe will be perforated or slotted and the remainder of the pipe to the surface will be solid. A sand pack of clean, coarse silica sand will be placed around the slotted portion of the pipe. The annular space above the sandpack will be sealed with a bentonite grout. ^{1' bentonite seal x ✓} The probes will be protected by a steel protective casing with a locking lid. If probes deeper than 20 feet are necessary, then two probes will be placed in the hole; one to monitor near the bottom of the hole and, the other to monitor halfway to the surface. This will help to ensure that the entire vadose zone is being monitored for gas migration. The probes will be capped with an airtight cap with a sampling access tube which can be valved or clamped shut between monitoring events. good

Methane monitoring will be performed by the City Fire Department with a calibrated combustible gas indicator or organic vapor analyzer which has been calibrated according to product specifications. ^(FID)



Proj. No: CHHL01
 Dwg. No: HLF2592S
 Scale: 1" = 500'
 Date: 3/23/93
 Rev Date: 4/9/93

Figure 6.1:
 Existing and Proposed Methane
 Monitoring Sites

Sampling will consist of extracting and analyzing one probe bore volume of air from each probe. Both the highest concentration read during this purge and the reading after one bore volume of air has been removed will be recorded. In addition to sampling with field equipment, at least one air bag sample per event will be obtained and sent to a professional laboratory for a natural gas analysis. This laboratory analysis will help correlate and validate the results obtained in the field survey.

Methane monitoring will occur at all monitoring locations on at least a quarterly basis. Special consideration will be given to field conditions in scheduling these monitoring events. The monitoring will be scheduled when possible to coincide with field conditions conducive to methane migration (ie. rain or snow covered surface, frozen ground etc...). Monitoring performed under these conditions may provide more conservative data and help provide "worst case" information as an added safeguard for nearby residents, businesses and facilities.

Due to the potential for methane accumulation in any part of the landfill, no excavation or construction shall be allowed in or adjacent to the landfill without proper methane surveys being performed. Federal safety regulations, (OSHA), outline the proper procedures to follow in such a case. The City of Helena shall notify all departments that may potentially access the landfill area of these procedures. In Appendix D is a letter sent to all of the utility companies that could be excavating in the landfill area. In addition, this letter was also sent to Carroll College, Elkriver Concrete, and necessary City of Helena personnel.

7.0 FUTURE LAND USE

The City of Helena has designated no specific use for the reclaimed landfill area at this time. A personal communication with Mr. Randy Lilje of the City of Helena Parks Department in June 1991, indicated that the land use currently being considered (but not committed to) would be a grassed park area similar to that of Centennial Park. This use would dictate that irrigation of the grass would need to be implemented and a soil moisture and water balance control system similar to that at Centennial Park would need to be implemented. Final land use will be determined by the City after all possible options have been evaluated.

8.0 REFERENCES

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APPENDIX A.

HELENA LANDFILL AREA WATER QUALITY

APPENDIX A - SUMMARY OF WATER QUALITY ANALYSES
OHL01 - City of Helena - Hlna Landfill Mtrng

Page: 1
08/19/92

Sample Type: Irrigation Well

SITE CODE I-3
SAMPLE DATE 05/08/90
SAMPLE TIME 11:40
LAB EL
LAB NUMBER 90-12196
REMARKS Golf Course W
SAMPLE NUMBER HL-9005-116

- golf course

-- VOLATILE ORGANICS --

1,1,1,2-TETRACHLOROETHANE	<.001	
1,1,1-TRICHLOROETHANE	0.0026	
1,1,2,2-TETRACHLOROETHANE	<.001	
1,1,2-TRICHLOROETHANE	<.001	
1,1-DICHLOROETHANE	0.0017	
1,1-DICHLOROETHENE	<.0005	
1,1-DICHLOROPROPENE	<.001	
1,2-DIBROMOETHANE	<.001	
1,2-DICHLOROETHANE	<.0005	
1,2-DICHLOROPROPANE	<.001	
2,2-DICHLOROPROPANE	<.001	
2-CHLOROTOLUENE	<.001	
4-CHLOROTOLUENE	<.001	
BENZENE	<.0005	<i>MAC .005 mg/L</i>
BROMOBENZENE	0.001	<i>no MAC</i>
BROMOCHLOROMETHANE	<.001	
BROMODICHLOROMETHANE	<.001	
BROMOFORM	<.001	
BROMOMETHANE	<.001	<i>MAC .1 mg/L</i>
CARBON TETRACHLORIDE	<.0005	<i>MAC .005 mg/L</i>
CHLOROBENZENE	<.001	
CHLOROETHANE	<.001	<i>no MAC</i>
CHLOROFORM	0.0038	<i>MAC .1 mg/L</i>
CHLOROMETHANE	0.001	<i>no MAC</i>
CIS-1,2-DICHLOROETHENE	0.0011	
CIS-1,3-DICHLOROPROPENE	<.001	
DIBROMOCHLOROMETHANE	<.001	
DIBROMOMETHANE	<.001	<i>MAC .1 mg/L</i>
DICHLORODIFLUOROMETHANE	0.0052	<i>MAC .1 mg/L</i>
ETHYLBENZENE	<.001	
M-XYLENE	<.001	
O-XYLENE	<.001	
P-XYLENE	<.001	
METHYLENE CHLORIDE	0.0011	
STYRENE	<.001	
TETRACHLOROETHENE	0.007	

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).

Sample Type: Irrigation Well

SITE CODE I-3
SAMPLE DATE 05/08/90
SAMPLE TIME 11:40
LAB EL
LAB NUMBER 90-12196
REMARKS Golf Course W
SAMPLE NUMBER HL-9005-116

-- VOLATILE ORGANICS --

TOLENE <0.001
TRANS-1,2-DICHLOROETHENE <0.001
TRANS-1,3-DICHLOROPROPENE <0.001
TRICHLOROETHENE 0.0011
TRICHLOROFLUOROMETHANE <0.001
VINYL CHLORIDE <0.0005

-- SEMI-VOLATILE EXTRACTABLES --

1,2,3-TRICHLOROBENZENE <0.001
1,2,3-TRICHLOROPROPANE <0.001
1,2,4-TRICHLOROBENZENE <0.001
1,2,4-TRIMETHYLBENZENE <0.001
1,2-DIBROMO-3-CHLOROPROPANE <0.001
1,2-DICHLOROBENZENE <0.001
1,3,5-TRIMETHYLBENZENE <0.001
1,3-DICHLOROBENZENE <0.001
1,3-DICHLOROPROPANE <0.001
1,4-DICHLOROBENZENE <0.0005
DICHLOROMONOFUOROMETHANE 0.0039
HEXACHLOROBUTADIENE <0.001
ISOPROPYLBENZENE <0.001
N-BUTYLBENZENE <0.001
N-PROPYLBENZENE <0.001
NAPHTHALENE <0.001
P-ISOPROPYLTOLUENE <0.001
SEC-BUTYLBENZENE <0.001
TERT-BUTYLBENZENE <0.001

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

APPENDIX A - SUMMARY OF WATER QUALITY ANALYSES
CHIL01 - City of Helena - Hlna Landfill Mtrng

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08/19/92

Sample Type: Monitoring Wells

SITe CODE		82-2	82-3	82-4	82-4	83-5	83-6	83-6	83-6
SAMPLE DATE		11/11/89	11/13/89	11/11/89	05/11/90	11/13/89	11/13/89	04/05/91	01/31/92
SAMPLE TIME		17:15	11:45	15:30	15:30	11:10	11:00	14:00	09:45
LAB		EL	HYDRO	EL	EL	HYDRO	HYDRO	EL	EL
LAB NUMBER		89-20181	HL-8911-904	89-20180	90-12199	HL-8911-901	HL-8911-900	91-12769	92-5001
SAMPLE NUMBER		HL-8911-002		HL-8911-001	HL-9005-122		HL-9104-106	HL-9201-111	
-- PHYSICAL PARAMETERS --									
DEPTH TO WATER LVL (FT)		14.81	58.46	59.05		11.91	12.97	12.14	12.31
TOTAL DEPTH OF WELL (FT)		24.0	87.0	79.0				23.0	23.2
PH								7.5	7.8
SC (UMHOS/CM @25 C)								511.0	629.0
TDS (@ 180 C)									421.0
TOTAL SUSPENDED SOLIDS									420.0
WATER TEMPERATURE (FLD)									11.5
-- COMMON IONS --									
CALCIUM (CA) (DIS)								114.0	89.0
MAGNESIUM (MG) (DIS)								31.0	25.0
SODIUM (NA) (DIS)								23.0	20.0
POTASSIUM (K) (DIS)								5.0	3.0
TOTAL ALKALINITY AS CA CO3								255.0	226.0
BICARBONATE (HCO3)								311.0	276.0
CARBONATE AS CO3								0.0	0.0
SULFATE (SO4)								109.0	86.0
CHLORIDE (CL)								32.0	26.0
-- NUTRIENTS --									
AMMONIA (NH3 AS N)								8.91	<0.1
NITRATE (NO3-N)								<0.1	4.27
NITRATE + NITRITE AS N									
NITROGEN AS N									
-- TRACE ELEMENTS --									
ARSENIC (AS) *DIS								<0.005	<0.005
BARIUM (BA) *DIS								<0.1	<0.1
CADMIUM (CD) *DIS								<0.001	<0.001
CHROMIUM (CR) *DIS								<0.02	<0.02
IRON (FE) *DIS								<0.03	0.09
LEAD (PB) *DIS								<0.01	<0.01
MANGANESE (MN) *DIS								0.04	0.05
MERCURY (HG) *DIS								<0.001	<0.001
SELENIUM (SE) *DIS								<0.005	<0.005
SILVER (AG) *DIS								<0.005	<0.005

* DIS - Dissolved

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

Sample Type: Monitoring Wells

	SITE CODE		82-2		82-3		82-4		82-4		83-5		83-6		83-6	
	SAMPLE DATE	11/11/89	SAMPLE TIME	17:15	11/13/89	11:45	11/11/89	15:30	05/11/90	15:30	11/13/89	11:10	11/13/89	11:00	04/05/91	09:45
	LAB	EL	LAB	EL	HYDRO	EL	EL	EL	EL	EL	HYDRO	EL	HYDRO	EL	EL	EL
	LAB NUMBER	89-20181	LAB	89-20181	LAB	89-20180	LAB	89-20180	LAB	90-12199	LAB	91-12769	LAB	91-12769	LAB	92-5001
	SAMPLE NUMBER	HL-8911-002	SAMPLE NUMBER	HL-8911-002	SAMPLE NUMBER	HL-8911-904	SAMPLE NUMBER	HL-8911-001	SAMPLE NUMBER	HL-9005-122	SAMPLE NUMBER	HL-8911-901	SAMPLE NUMBER	HL-8911-900	SAMPLE NUMBER	HL-9201-111
-- VOLATILE ORGANICS --																
1,1,1,2-TETRACHLOROETHANE		<0.001		<0.001				<0.001								
1,1,1-TRICHLOROETHANE		<0.0005		<0.0005				0.01								
1,1,2,2-TETRACHLOROETHANE		<0.001		<0.001				<0.001								
1,1,2-TRICHLOROETHANE		<0.001		<0.001				0.0028								
1,1-DICHLOROETHANE		<0.0005		<0.0005				<0.0005								
1,1-DICHLOROPROPENE		<0.001		<0.001				<0.001								
1,2-DIBROMOETHANE		<0.001		<0.001				<0.001								
1,2-DICHLOROETHANE		<0.0005		<0.0005				<0.0005								
1,2-DICHLOROPROPANE		<0.001		<0.001				<0.001								
2,2-DICHLOROPROPANE		<0.001		<0.001				<0.001								
2-BUTANONE (METHYL-ETHYL-KETONE)																
2-CHLOROETHYL VINYL ETHER																
2-CHLOROTOLUENE		<0.001		<0.001				<0.001								
2-HEXANONE																
4-BROMOFLUOROBENZENE																
4-CHLOROTOLUENE																
4-METHYL-2-PENTANONE																
ACETONE																
ACROLEIN																
ACRYLONITRILE																
BENZENE		<0.0005		<0.0005				<0.0005								
BROMOBENZENE		<0.001		<0.001				<0.001								
BROMOCHLOROMETHANE		<0.001		<0.001				<0.001								
BROMODICHLOROMETHANE		<0.001		<0.001				<0.001								
BROMOFORM		<0.001		<0.001				<0.001								
BROMOMETHANE		<0.001		<0.001				<0.001								
CARBON DISULFIDE																
CARBON TETRACHLORIDE		<0.0005		<0.0005				<0.0005								
CHLOROBENZENE		<0.001		<0.001				<0.001								
CHLOROETHANE		<0.001		<0.001				<0.001								
CHLOROFORM		<0.001		<0.001				<0.001								
CHLOROMETHANE		<0.001		<0.001				<0.001								
CIS-1,2-DICHLOROETHENE		<0.001		<0.001				<0.001								
CIS-1,3-DICHLOROPROPENE		<0.001		<0.001				<0.001								
DIBROMOCHLOROMETHANE		<0.001		<0.001				<0.001								

* DIS - Dissolved

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

Sample Type: Monitoring Wells

SITE CODE	82-2	82-3	82-4	82-5	83-6	83-6	83-6
SAMPLE DATE	11/11/89	11/13/89	11/11/89	11/13/89	11/13/89	04/05/91	01/31/92
SAMPLE TIME	17:15	11:45	15:30	11:45	11:00	14:00	09:45
LAB	EL	HYDRO	EL	HYDRO	HYDRO	EL	
LAB NUMBER	89-20181	HL-8911-904	89-20180	HL-8911-901	HL-8911-900	91-12769	92-5001
SAMPLE NUMBER	HL-8911-002		HL-8911-001	HL-9005-122	HL-9104-106	HL-9201-111	
— VOLATILE ORGANICS —							
DIBROMOMETHANE	<0.001		<0.001		<0.001	<0.001	<0.001
DICHLOROFLUOROMETHANE	<0.001		0.069		<0.001	<0.001	<0.001
ETHANOL							
ETHYL METHACRYLATE							
ETHYLBENZENE	<0.001		<0.001		<0.001	<0.001	<0.001
IODOMETHANE							
XYLENE							
M-XYLENE	<0.001		<0.001		<0.001	<0.001	<0.001
O-XYLENE	<0.001		<0.001		<0.001	<0.001	<0.001
P-XYLENE	<0.001		<0.001		<0.001	<0.001	<0.001
METHYLENE CHLORIDE	<0.001		0.0077		<0.001	<0.001	<0.001
STYRENE	<0.001		<0.001		<0.001	<0.001	<0.001
TETRACHLOROETHENE	<0.0005		0.0049		<0.001	<0.0005	0.0036
TOLUENE	<0.001		<0.001		<0.001	<0.001	<0.001
TRANS-1,2-DICHLOROETHENE	<0.001		<0.001		<0.001	<0.001	<0.001
TRANS-1,3-DICHLOROPROPENE	<0.001		<0.001		<0.001	<0.001	<0.001
TRICHLOROETHENE	<0.0005		0.0029		<0.001	<0.0005	<0.0005
TRICHLOROFLUOROMETHANE	<0.001		0.042		<0.001	<0.001	<0.001
VINYL ACETATE							<0.001
VINYL CHLORIDE	<0.0005		<0.0005			<0.0005	<0.0005
MI-VOLATILE EXTRACTABLES —							
1,2,3-TRICHLOROBENZENE	<0.001		<0.001			<0.001	<0.001
1,2,3-TRICHLOROPROPANE	<0.001		<0.001				
1,2,4-TRICHLOROBENZENE	<0.001		<0.001				
1,2,4-TRIMETHYLBENZENE	<0.001		<0.001				
1,2-DIBROMO-3-CHLOROPROPANE	<0.001		<0.001				
1,2-DICHLOROBENZENE	<0.001		<0.001				
1,3,5-TRIMETHYLBENZENE	<0.001		<0.001				
1,3-DICHLOROBENZENE	<0.001		<0.001				
1,3-DICHLOROPROPANE	<0.001		<0.001				
1,4-DICHLORO-2-BUTENE	<0.001		<0.001				
1,4-DICHLOROBENZENE	<0.0005		<0.0005				
1,4-DIFLUOROBENZENE							
2-METHYL-4,6-DINITROPHENOL							
2,4,6-TRICHLOROPHENOL							

★ DIS - Dissolved

All quantities in mg/L (water) or mg/kg (soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD). Blank line indicates parameter not tested.

Sample Type: Monitoring Wells

SITE CODE	82-2	82-3	82-4	82-4	83-5	83-6	83-6	83-6
SAMPLE DATE	11/11/89	11/13/89	11/11/89	11/11/89	11/13/89	11/13/89	04/05/91	01/31/92
SAMPLE TIME	17:15	11:45	15:30	15:30	11:10	11:00	14:00	09:45
LAB	EL	HYDRO	EL	EL	HYDRO	HYDRO	EL	EL
LAB NUMBER	89-20181		89-20180	89-20180			91-12769	92-5001
SAMPLE NUMBER	HL-8911-002	HL-8911-904	HL-8911-001	HL-8911-001	HL-8911-901	HL-8911-900	HL-9104-106	HL-9201-111

-- SEMI-VOLATILE EXTRACTABLES --

2,4-DICHLOROPHENOL	<0.01
2,4-DIMETHYLPHENOL	<0.01
2,4-DINITROPHENOL	<0.05
2,4-DINITROTOLUENE	<0.01
2,6-DINITROTOLUENE	<0.01
2-CHLORONAPHTHALENE	<0.01
2-CHLOROPHENOL	<0.01
2-NITROPHENOL	<0.01
3,3-DICHLOROBENZIDINE	<0.01
4-BROMOPHENYL PHENYL ETHER	<0.01
4-CHLORO-3-METHYLPHENOL	<0.01
4-CHLOROPHENYL PHENYL ETHER	<0.01
4-NITROPHENOL	<0.01
ACENAPHTHENE	<0.05
ACENAPHTHYLENE	<0.01
ANTHRACENE	<0.01
1,2-DIPHENYLHYDRAZINE (AZOBENZEN	<0.01
BENZIDINE	<0.01
BENZO (A) ANTHRACENE	<0.01
BENZO (A) PYRENE	<0.01
BENZO (B) FLUORANTHENE	<0.01
BENZO (GH) PERYLENE	<0.01
BENZO (K) FLUORANTHENE	<0.01
BIS (2-CHLOROETHOXY) METHANE	<0.01
BIS (2-CHLOROETHYL) ETHER	<0.01
BIS (2-CHLOROISOPROPYL) ETHER	<0.01
BIS (2-ETHYLHEXYL) PHTHALATE	<0.01
BUTYL BENZYL PHTHALATE	<0.01
CHRYSENE	<0.01
DI-N-BUTYLPHTHALATE	<0.01
DI-N-OCTYLPHTHALATE	<0.01
DIBENZO (A,H) ANTHRACENE	<0.01
DICHLOROMONOFUOROMETHANE	<0.01
DIETHYLPHTHALATE	<0.01
DIMETHYLPHTHALATE	<0.01
FLUORANTHENE	<0.01
	0.031

* DIS - Dissolved

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

APPENDIX A - SUMMARY OF WATER QUALITY ANALYSES
OHL01 - City of Helena - Huna Landfill Mtnrg

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Sample Type: Monitoring Wells

SITE CODE	82-2	82-3	82-4	82-4	83-5	83-6	83-6	83-6
SAMPLE DATE	11/11/89	11/13/89	05/11/90	11/11/89	11/13/89	11/13/89	04/05/91	01/31/92
SAMPLE TIME	17:15	11:45	15:30	15:30	11:10	11:00	14:00	09:45
LAB	EL	HYDRO	EL	EL	HYDRO	HYDRO	EL	EL
LAB NUMBER	89-20181		90-12199	89-20180			91-12769	92-5001
SAMPLE NUMBER	HL-8911-002	HL-8911-904	HL-9005-122	HL-8911-001	HL-8911-901	HL-8911-900	HL-9104-106	HL-9201-111
-- SEMI-VOLATILE EXTRACTABLES --								
FLUORENE								
HEXACHLOROBENZENE								
HEXACHLOROBUTADIENE	<0.001			<0.001				
HEXACHLOROETHANE								
INDENO (1,2,3-CD) PYRENE								
ISOPHORONE								
ISOPROPYLBENZENE	<0.001			<0.001				
N-BUTYLBENZENE	<0.001			<0.001				
N-NITROSO-DI-N-PROPYLAMINE								
N-NITROSO-PHENYLAMINE								
N-PROPYLBENZENE	<0.001			<0.001				
NAPHTHALENE	<0.001			<0.001				
NITROBENZENE								
P-ISOPROPYLTOLUENE	<0.001			<0.001				
PENTACHLOROPHENOL								
PHENANTHRENE								
PHENOL								
PYRENE								
SEC-BUTYLBENZENE	<0.001			<0.001				
TERT-BUTYLBENZENE	<0.001			<0.001				
-- HYDROCARBONS --								
ORGANIC CARBON								
-- OTHER PARAMETERS --								
CYANIDE (CN)								
CYANIDE (CN) *TOT								
CHEMICAL OXYGEN DEMAND								
* DIS - Dissolved								
* TOT - Total								
							<2.0	<0.005
							<1.0	<1.0

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

APPENDIX A - SUMMARY OF WATER QUALITY ANALYSES
CHL01 - City of Helena - Helena Landfill Mtnng

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Sample Type: Monitoring Wells

SITE CODE	83-6	83-7	EPA-1	EPA-1	FAIR GRND	HL-1	HL-1
SAMPLE DATE	05/19/92	11/11/89	04/05/91	01/22/92	06/06/90	11/13/89	05/06/90
SAMPLE TIME	16:30	18:35	12:00	09:45	10:45	11:30	11:25
LAB	EL	EL	EL	EL	EL	EL	EL
LAB NUMBER	92-19274	89-20183	91-12768	92-4687	90-15039	89-20185	90-10827
SAMPLE NUMBER	HL-9205-103	HL-8911-004	HL-9104-105	HL-9201-103	HL-9006-101	HL-8911-006	HL-9005-110

-- PHYSICAL PARAMETERS --

DEPTH TO WATER LVL (FT)	12.79	33.7	45.07	44.73	45.37	17.53	
TOTAL DEPTH OF WELL (FT)	23.0	40.0	54.5	59.0	59.0	20.0	
PH (FLD)	7.36						
PH	7.6						
SC (UMHOS/CM @25 C) (FLD)	680.0						
SC (UMHOS/CM @25 C)	667.0						
TDS @ 180 C	425.0						
TOTAL SUSPENDED SOLIDS	10.0			10.0			
WATER TEMPERATURE (FLD)	13.2						

-- COMMON IONS --

CALCIUM (CA) (DIS)	94.0						
MAGNESIUM (MG) (DIS)	27.0						
SODIUM (NA) (DIS)	22.0						
POTASSIUM (K) (DIS)	4.0						
TOTAL ALKALINITY AS CaCO3	256.0						
BICARBONATE (HCO3)	313.0						
CARBONATE AS CO3	0.0						
SULFATE (SO4)	89.0						
CHLORIDE (CL)	28.0						

-- NUTRIENTS --

AMMONIA (NH3 AS N)	<0.1						
NITRATE (NO3-N)	4.02						

-- TRACE ELEMENTS --

ARSENIC (AS) *DIS	<0.005						
BARIUM (BA) *DIS	<0.1						
CADMIUM (CD) *DIS	<0.001						
CHROMIUM (CR) *DIS	<0.01						
IRON (FE) *DIS	0.1						
LEAD (PB) *DIS	<0.01						
MANGANESE (MN) *DIS	<0.02						
MERCURY (HG) *DIS	<0.001						
SELENIUM (SE) *DIS	<0.005						

* DIS - Dissolved
* TOT - Total

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

EPA-1	EPA-1	EPA-1	FAIR GRND
06/05/91	01/22/92	05/20/92	06/05/90
12:00	09:45	13:30	10:45
EL	EL	EL	EL
91-12768	92-4687	92-19275	90-15039
HL-9104-105	HL-9201-103	HL-9205-123	HL-9006-101

* DIS - Dissolved
* TOT - Total

ALL quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. ALL results are LABORATORY unless otherwise specified as field (FLD). Blank line indicates parameter not tested.

APPENDIX A - SUMMARY OF WATER QUALITY ANALYSES
GH101 - City of Helena - Huna Landfill Mtnng

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08/19/92

Sample Type: Monitoring Wells

-- VOLATILE ORGANICS --	SITE CODE		83-6		83-7		EPA-1		EPA-1		FAIR GRND		HL-1		HL-1	
	SAMPLE DATE	SAMPLE TIME	LAB	EL	11/11/89	18:35	04/05/91	12:00	01/22/92	09:45	05/20/92	13:30	11/13/89	11:30	05/06/90	11:25
	LAB NUMBER	92-19274	EL	EL	89-20183	EL	91-12768	EL	92-4687	EL	90-15039	EL	89-20185	EL	90-10827	EL
	SAMPLE NUMBER	HL-9205-103	HL-9205-103	HL-9205-103	HL-8911-004	HL-9104-105	HL-9201-103	HL-9205-123	HL-9201-103	HL-9205-123	HL-9206-101	HL-9206-101	HL-8911-006	HL-8911-006	HL-9005-110	HL-9005-110
CHLOROFORM	0.0012	<0.001	<0.001	<0.001	<0.001	<0.001	0.007	0.016	0.015	0.016	0.088	0.0035	0.0035	0.0035	0.0079	0.0079
CHLOROMETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
CIS-1,2-DICHLOROETHENE	<0.001	0.0044	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
CIS-1,3-DICHLOROPROPENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
DIBROMOCHLOROMETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
DIBROMOMETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
DICHLORODIFLUOROMETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.011	0.016	0.007	0.016	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
ETHANOL	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
ETHYL METHACRYLATE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
ETHYLBENZENE	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
IODOETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
XYLENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
M-XYLENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
O-XYLENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
P-XYLENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
METHYLENE CHLORIDE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
STYRENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
TETRACHLOROETHENE	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0042	0.0034	0.0034	0.0012	<0.005	<0.005	<0.005	<0.005	0.00083	0.00083
TOLUENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
TRANS-1,2-DICHLOROETHENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
TRANS-1,3-DICHLOROPROPENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
TRICHLOROETHENE	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0074	0.0054	0.0054	0.0059	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
TRICHLOROFUOROMETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0043	0.0078	0.0078	0.0083	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
VINYL ACETATE	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
VINYL CHLORIDE	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
-- SEMI-VOLATILE EXTRACTABLES --																
1,2,3-TRICHLOROETHENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,2,3-TRICHLOROPROPANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,2,4-TRICHLOROETHENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,2,4-TRIMETHYLBENZENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,2-DIBROMO-3-CHLOROPROPANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,2-DICHLOROETHENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,3,5-TRIMETHYLBENZENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,3-DICHLOROETHENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

* DIS - Dissolved
* TOT - Total

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

APPENDIX A - SUMMARY OF WATER QUALITY ANALYSES
CHL01 - City of Helena - Hlna Landfill Mtrng

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08/19/92

Sample Type: Monitoring Wells

	83-6		83-7		EPA-1		EPA-1		FAIR GRND		HL-1	
	SITE CODE	05/19/92	11/11/89	18:35	04/05/91	01/22/92	05/20/92	06/05/90	11/13/89	05/06/90	11/13/89	05/06/90
	SAMPLE TIME	16:30	EL	EL	12:00	09:45	13:30	10:45	11:30	11:25	EL	EL
	LAB	92-19274	89-20183	HL-8911-004	91-12768	92-4687	92-19275	90-15039	89-20185	90-10827	HL-8911-006	90-10827
	SAMPLE NUMBER	HL-9205-103	HL-8911-004	HL-9104-105	HL-9201-103	HL-9205-123	HL-9006-101	HL-9005-110				
-- SEMI-VOLATILE EXTRACTABLES --												
1,3-DICHLOROPROPANE			<0.001					<0.001	<0.001	<0.001	<0.001	<0.001
1,4-DICHLORO-2-BUTENE			<0.0005					<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
1,4-DICHLOROBENZENE			<0.001					<0.001	<0.001	<0.001	<0.001	<0.001
1,4-DIFLUOROBENZENE												
DICHLOROMONOFLUOROMETHANE												
HEXACHLOROBUTADIENE												
ISOPROPYLBENZENE												
N-BUTYLBENZENE												
N-PROPYLBENZENE												
NAPHTHALENE												
P-ISOPROPYLTOLUENE												
SEC-BUTYLBENZENE												
TERT-BUTYLBENZENE												
-- OTHER PARAMETERS --												
CYANIDE (CN) *TOT		<0.005										
CHEMICAL OXYGEN DEMAND		<1.0										

* DIS - Dissolved
* TOT - Total

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

APPENDIX A - SUMMARY OF WATER QUALITY ANALYSES
CHL01 - City of Helena - Helena Landfill Mtnng

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08/19/92

Sample Type: Monitoring Wells

SITE CODE	HL-2	HL-3	HL-5	HL-5	HL-6	HL-7	HL-90-1
SAMPLE DATE	11/13/89	11/13/89	11/13/89	05/06/90	05/06/90	11/11/89	02/02/90
SAMPLE TIME	11:20	11:50	11:40	11:45	12:00	17:55	16:15
LAB	HYDRO	HYDRO	HYDRO	EL	EL	EL	EL
LAB NUMBER				90-10829	90-10830	89-20182	90-2766
SAMPLE NUMBER	HL-8911-902	HL-8911-903	HL-8911-905	HL-9005-112	HL-9005-113	HL-8911-003	HL-90-2-101
-- PHYSICAL PARAMETERS --							
DEPTH TO WATER LVL (FT)	27.17	DRY	29.31			10.41	49.19
TOTAL DEPTH OF WELL (FT)	30.0		31.44			18.0	68.0
PH							7.8
SC (UMFOS/CM @25 C)							1100.0
TDS (@ 180 C)							685.0
-- COMMON IONS --							
TOTAL HARDNESS AS CaCO3							528.0
CALCIUM (CA) (DIS)							137.0
MAGNESIUM (MG) (DIS)							45.0
SODIUM (NA) (DIS)							35.0
POTASSIUM (K) (DIS)							3.0
TOTAL ALKALINITY AS CaCO3							395.0
BICARBONATE (HCO3)							482.0
CARBONATE AS CO3							0.0
SULFATE (SO4)							132.0
CHLORIDE (CL)							31.0
-- NUTRIENTS --							
NITRATE + NITRITE AS N							8.4
-- TRACE ELEMENTS --							
CADMIUM (CD) #DIS							0.005
COPPER (CU) #DIS							<0.01
IRON (FE) #DIS							<0.03
LEAD (PB) #DIS							<0.01
ZINC (ZN) #DIS							0.02
-- VOLATILE ORGANICS --							
1,1,1,2-TETRACHLOROETHANE							<0.001
1,1,1-TRICHLOROETHANE							0.0074
1,1,2,2-TETRACHLOROETHANE							<0.001
1,1,2-TRICHLOROETHANE							<0.001
1,1-DICHLOROETHANE							0.0026

* DIS - Dissolved
* TOT - Total

ALL quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

APPENDIX A - SUMMARY OF WATER QUALITY ANALYSES
CHLD01 - City of Helena - Helena Landfill Mtn

Page: 13
08/19/92

Sample Type: Monitoring Wells

SITE CODE	HL-2	HL-3	HL-5	HL-5	HL-6	HL-7	HL-90-1
SAMPLE DATE	11/13/89	11/13/89	11/13/89	05/06/90	05/06/90	11/11/89	02/02/90
SAMPLE TIME	11:20	11:50	11:40	11:45	12:00	17:55	16:15
LAB	HYDRO	HYDRO	HYDRO	EL	EL	EL	EL
LAB NUMBER				90-10829	90-10830	89-20182	90-2766
SAMPLE NUMBER	HL-8911-902	HL-8911-903	HL-8911-905	HL-9005-112	HL-9005-113	HL-8911-003	HL-90-2-101
--- VOLATILE ORGANICS ---							
1,1-DICHLOROETHENE				<0.0005	<0.0005	<0.0005	<0.0005
1,1-DICHLOROPROPENE				<0.001	<0.001	<0.001	<0.001
1,2-DIBROMOETHANE				<0.001	<0.001	<0.001	<0.001
1,2-DICHLOROETHANE				<0.0005	<0.0005	<0.0005	0.00058
1,2-DICHLOROPROPANE				<0.001	<0.001	<0.001	<0.001
2,2-DICHLOROPROPANE				<0.001	<0.001	<0.001	<0.001
2-CHLOROTOLUENE				<0.001	<0.001	<0.001	<0.001
4-CHLOROTOLUENE				<0.001	<0.001	<0.001	<0.001
BENZENE				<0.0005	<0.0005	<0.0005	<0.0005
BROMOBENZENE				<0.001	<0.001	<0.001	<0.001
BROMOCHLOROMETHANE				<0.001	<0.001	<0.001	<0.001
BROMODICHLOROMETHANE				<0.001	<0.001	<0.001	<0.001
BROMOFORM				<0.001	<0.001	<0.001	<0.001
BROMOMETHANE				<0.001	<0.001	<0.001	<0.001
CARBON TETRACHLORIDE				<0.001	<0.001	<0.001	<0.001
CHLOROBENZENE				<0.001	<0.001	<0.001	<0.001
CHLOROETHANE				<0.0005	<0.0005	<0.0005	<0.0005
CHLOROFORM				<0.001	<0.001	<0.001	<0.001
CHLOROMETHANE				0.0023	0.002	0.0023	0.0035
CIS-1,2-DICHLOROETHENE				<0.001	<0.001	<0.001	<0.001
CIS-1,3-DICHLOROPROPENE				<0.001	<0.001	<0.001	<0.001
DIBROMOCHLOROMETHANE				<0.001	<0.001	<0.001	<0.001
DIBROMOMETHANE				<0.001	<0.001	<0.001	<0.001
DICHLORODIFLUOROMETHANE				0.001	<0.001	0.016	0.015
ETHYLBENZENE				<0.001	<0.001	<0.001	<0.001
M-XYLENE				<0.001	<0.001	<0.001	<0.001
O-XYLENE				<0.001	<0.001	<0.001	<0.001
P-XYLENE				<0.001	<0.001	<0.001	<0.001
METHYLENE CHLORIDE				<0.001	<0.001	<0.001	<0.001
STYRENE				<0.001	<0.001	0.0017	0.0036
TETRACHLOROETHENE				<0.0005	<0.0005	<0.001	<0.001
TOLUENE				<0.001	<0.001	0.0045	0.013
TRANS-1,2-DICHLOROETHENE				<0.001	<0.001	<0.001	<0.001
TRANS-1,3-DICHLOROPROPENE				<0.001	<0.001	<0.001	<0.001

* DIS - Dissolved
* TOT - Total

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

APPENDIX A - SUMMARY OF WATER QUALITY ANALYSES
CHL01 - City of Helena - Helena Landfill Mtnng

Page: 14
08/19/92

Sample Type: Monitoring Wells

SITE CODE	HL-2	HL-3	HL-5	HL-5	HL-6	HL-7	HL-90-1
SAMPLE DATE	11/13/89	11/13/89	11/13/89	05/06/90	05/06/90	11/11/89	02/02/90
SAMPLE TIME	11:20	11:50	11:40	11:45	12:00	17:55	16:15
LAB	HYDRO	HYDRO	HYDRO	EL	EL	EL	EL
LAB NUMBER				90-10829	90-10830	89-20182	90-2766
SAMPLE NUMBER	HL-8911-902	HL-8911-903	HL-8911-905	HL-9005-112	HL-9005-113	HL-8911-003	HL-90-2-101
-- VOLATILE ORGANICS --							
TRICHLOROETHENE				<0.0005	<0.0005	0.0035	0.0015
TRICHLOROFLUOROMETHANE				<0.001	<0.001	<0.001	<0.001
VINYL CHLORIDE				<0.0005	<0.0005	<0.0005	<0.0005
-- SEMI-VOLATILE EXTRACTABLES --							
1,2,3-TRICHLOROETHENE				<0.001	<0.001	<0.001	<0.001
1,2,3-TRICHLOROPROPANE				<0.001	<0.001	<0.001	<0.001
1,2,4-TRICHLOROETHENE				<0.001	<0.001	<0.001	<0.001
1,2,4-TRIMETHYLBENZENE				<0.001	<0.001	<0.001	<0.001
1,2-DIBROMO-3-CHLOROPROPANE				<0.001	<0.001	<0.001	<0.001
1,2-DICHLOROETHENE				<0.001	<0.001	<0.001	<0.001
1,3,5-TRIMETHYLBENZENE				<0.001	<0.001	<0.001	<0.001
1,3-DICHLOROETHENE				<0.001	<0.001	<0.001	<0.001
1,3-DICHLOROPROPANE				<0.001	<0.001	<0.001	<0.001
1,4-DICHLOROETHENE				<0.0005	<0.0005	<0.0005	<0.0005
DICHLOROMONOFLUOROMETHANE				<0.001	<0.001	0.0063	0.0069
HEXACHLOROETHADIENE				<0.001	<0.001	<0.001	<0.001
ISOPROPYLBENZENE				<0.001	<0.001	<0.001	<0.001
N-BUTYLBENZENE				<0.001	<0.001	<0.001	<0.001
N-PROPYLBENZENE				<0.001	<0.001	<0.001	<0.001
NAPHTHALENE				<0.001	<0.001	<0.001	<0.001
P-ISOPROPYLTOLUENE				<0.001	<0.001	<0.001	<0.001
SEC-BUTYLBENZENE				<0.001	<0.001	<0.001	<0.001
TERT-BUTYLBENZENE				<0.001	<0.001	<0.001	<0.001

* DIS - Dissolved
* TOT - Total

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

ALL quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. ALL results are LABORATORY unless otherwise specified as field (FLD). Blank Line indicates parameter not tested.

Sample Type: Monitoring Wells

* DIS - Dissolved
* TOT - Total

ALL quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD). Blank line indicates parameter not tested.

Sample Type: Monitoring Wells

[illegible]

* DIS - Dissolved
* TOT - Total

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD). Blank line indicates parameter not tested.

APPENDIX A - SUMMARY OF WATER QUALITY ANALYSES
CHIL01 - City of Helena - Helena Landfill Mtnng

Sample Type: Monitoring Wells

[illegible]

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD). Blank line indicates parameter not tested.

Sample Type: Monitoring Wells

SITE CODE	HL-90-3	HL-90-3	HL-90-3
SAMPLE DATE	02/02/90	04/05/91	05/19/92
SAMPLE TIME	14:30	14:30	10:30
LAB	EL	EL	EL
LAB NUMBER	90-2765	91-12770	92-19269
SAMPLE NUMBER	HL-90-2-100	HL-9104-107	HL-9201-100
			HL-9205-109

--- PHYSICAL PARAMETERS ---

DEPTH TO WATER LVL (FT)	57.81	55.47	56.71
TOTAL DEPTH OF WELL (FT)	79.0	79.0	79.0
PH (FLD)	7.5	7.7	7.08
PH			7.9
SC (UMHOS/CM @25 C) (FLD)			1000.0
SC (UMHOS/CM @25 C)	1130.0		1040.0
TDS (@ 180 C)	686.0	662.0	626.0
TOTAL SUSPENDED SOLIDS			83.0
WATER TEMPERATURE (FLD)			12.4

--- COMMON IONS ---

TOTAL HARDNESS AS CaCO3	435.0		
CALCIUM (CA) (DIS)	109.0	108.0	93.0
MAGNESIUM (MG) (DIS)	40.0	39.0	41.0
SODIUM (NA) (DIS)	80.0	83.0	94.0
POTASSIUM (K) (DIS)	3.0	4.0	2.0
TOTAL ALKALINITY AS CaCO3	400.0	393.0	405.0
BICARBONATE (HCO3)	488.0	479.0	494.0
CARBONATE AS CO3	0.0	0.0	0.0
SULFATE (SO4)	136.0	134.0	156.0
CHLORIDE (CL)	30.0	29.0	28.0

--- NUTRIENTS ---

AMMONIA (NH3 AS N)		<0.1	<0.1
NITRATE + NITRITE AS N	5.7	6.3	
NITROGEN AS N			7.07

--- TRACE ELEMENTS ---

ARSENIC (AS) *DIS		<0.005	<0.005
BARIUM (BA) *DIS		<0.1	<0.1
CADMIUM (CD) *DIS	0.006	0.001	<0.001
CHROMIUM (CR) *DIS		<0.02	<0.01
COPPER (CU) *DIS	<0.01		
IRON (FE) *DIS	<0.03	<0.03	<0.03
LEAD (PB) *DIS	<0.01	<0.01	<0.01

* DIS - Dissolved
* TOT - Total

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

APPENDIX A - SUMMARY OF WATER QUALITY ANALYSES
CHIL01 - City of Helena - Hilna Landfill Mtnng

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Sample Type: Monitoring Wells

SITE CODE	HL-90-3	HL-90-3	HL-90-3
SAMPLE DATE	02/02/90	04/05/91	01/21/92
SAMPLE TIME	14:30	14:30	14:00
LAB	EL	EL	EL
LAB NUMBER	90-2765	91-12770	92-4683
SAMPLE NUMBER	HL-90-2-100	HL-9104-107	HL-9201-100
			HL-9205-109

-- TRACE ELEMENTS --

MANGANESE (MN) *DIS	<0.02	<0.02	<0.02
MERCURY (HG) *DIS	<0.001	<0.001	<0.001
SELENIUM (SE) *DIS	<0.005	<0.005	<0.005
SILVER (AG) *DIS	<0.005	<0.005	<0.005
ZINC (ZN) *DIS	0.02		

-- VOLATILE ORGANICS --

1,1,1,2-TETRACHLOROETHANE	<0.001	<0.005	<0.005
1,1,1-TRICHLOROETHANE	<0.005	<0.001	<0.001
1,1,2,2-TETRACHLOROETHANE	<0.001	<0.001	<0.001
1,1,2-TRICHLOROETHANE	0.0011	<0.001	<0.001
1,1-DICHLOROETHANE	<0.005	<0.005	<0.005
1,1-DICHLOROETHENE	<0.001		
1,1-DICHLOROPROPENE	<0.001		
1,2-DIBROMOETHANE	<0.001		
1,2-DICHLOROETHANE	<0.005	<0.005	<0.005
1,2-DICHLOROPROPANE	<0.001		
2,2-DICHLOROPROPANE	<0.001		
2-BUTANONE (METHYL-ETHYL-KETONE)			
2-CHLOROETHYL VINYL ETHER			
2-CHLOROTOLUENE	<0.001	<0.01	<0.01
2-HEXANONE			
4-BROMOFLUOROBENZENE			
4-CHLOROTOLUENE	<0.001	<0.01	<0.01
4-METHYL-2-PENTANONE			
ACETONE			
ACROLEIN			
ACRYLONITRILE			
BENZENE	<0.005	<0.005	<0.005
BROMOBENZENE	<0.001		
BROMOCHLOROMETHANE	<0.001	<0.001	<0.001
BROMODICHLOROMETHANE	<0.001	<0.001	<0.001
BROMOFORM	<0.001	<0.001	<0.001
BROMOMETHANE	<0.001	<0.001	<0.001
CARBON DISULFIDE		<0.01	

* DIS - Dissolved

* TOT - Total

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

APPENDIX A - SUMMARY OF WATER QUALITY ANALYSES
CHL01 - City of Helena - Hlna Landfill Mtnng

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08/19/92

Sample Type: Monitoring Wells

	HL-90-3		HL-90-3		HL-90-3	
	SITE CODE	HL-90-3	02/02/90	04/05/91	01/21/92	HL-90-3
SAMPLE DATE						05/19/92
SAMPLE TIME		14:30	14:30	14:30	14:00	10:30
LAB	EL	EL	EL	EL	EL	EL
LAB NUMBER	90-2765	91-12770	92-4683	92-19269	92-19269	92-19269
SAMPLE NUMBER	HL-90-2-100	HL-9104-107	HL-9201-100	HL-9205-109	HL-9205-109	HL-9205-109
--- VOLATILE ORGANICS ---						
CARBON TETRACHLORIDE		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
CHLOROBENZENE		<0.001	<0.001	<0.001	<0.001	<0.001
CHLOROETHANE		<0.001	<0.001	<0.001	<0.001	<0.001
CHLOROFORM		0.0055	0.0058	0.0043	0.004	0.004
CHLOROMETHANE		<0.001	<0.001	<0.001	<0.001	<0.001
CIS-1,2-DICHLOROETHENE		0.0018	<0.001	<0.001	<0.001	<0.001
CIS-1,3-DICHLOROPROPENE		<0.001	<0.001	<0.001	<0.001	<0.001
DIBROMOCHLOROMETHANE		<0.001	<0.001	<0.001	<0.001	<0.001
DIBROMOMETHANE		<0.001	<0.001	<0.001	<0.001	<0.001
DICHLOROFLUOROMETHANE		0.0013	<0.001	<0.001	<0.001	<0.001
ETHANOL			<0.01	<0.01	<0.01	<0.01
ETHYL METHACRYLATE		<0.01	<0.01	<0.01	<0.01	<0.01
ETHYLBENZENE			<0.01	<0.01	<0.01	<0.01
IODOMETHANE			<0.01	<0.01	<0.01	<0.01
XYLENE			<0.001	<0.001	<0.001	<0.001
N-XYLENE		<0.001				
O-XYLENE		<0.001				
P-XYLENE		<0.001				
METHYLENE CHLORIDE		<0.001	<0.001	<0.001	<0.001	<0.001
STYRENE		0.0026	0.0019	0.0011	0.0017	0.0017
TETRACHLOROETHENE		<0.001	<0.001	<0.001	<0.001	<0.001
TOLUENE		<0.001	<0.001	<0.001	<0.001	<0.001
TRANS-1,2-DICHLOROETHENE		<0.001	<0.001	<0.001	<0.001	<0.001
TRANS-1,3-DICHLOROPROPENE		<0.001	<0.001	<0.001	<0.001	<0.001
TRICHLOROETHENE		0.0006	0.00065	<0.0005	<0.0005	<0.0005
TRICHLOROFLUOROMETHANE		<0.001	<0.001	<0.001	<0.001	<0.001
VINYL ACETATE		<0.001	<0.01	<0.01	<0.01	<0.01
VINYL CHLORIDE		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
--- SEMI-VOLATILE EXTRACTABLES ---						
1,2,3-TRICHLOROBENZENE		<0.001	<0.001	<0.001	<0.001	<0.001
1,2,3-TRICHLOROPROPANE		<0.001	<0.001	<0.001	<0.001	<0.001
1,2,4-TRICHLOROBENZENE		<0.001	<0.001	<0.001	<0.001	<0.001
1,2,4-TRIMETHYLBENZENE		<0.001	<0.001	<0.001	<0.001	<0.001
1,2-DIBROMO-3-CHLOROPROPANE		<0.001	<0.001	<0.001	<0.001	<0.001

* DIS - Dissolved
* TOT - Total

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

APPENDIX A - SUMMARY OF WATER QUALITY ANALYSES
CHH101 - City of Helena - HUna Landfill Mtrmg

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Sample Type: Monitoring Wells

SITE CODE	HL-90-3	HL-90-3	HL-90-3
SAMPLE DATE	02/02/90	04/05/91	05/19/92
SAMPLE TIME	14:30	14:30	10:30
LAB	EL	EL	EL
LAB NUMBER	90-2765	91-12770	92-19269
SAMPLE NUMBER	HL-90-2-100	HL-9104-107	HL-9205-109

-- SEMI-VOLATILE EXTRACTABLES --

1,2-DICHLOROBENZENE	<0.001	<0.01	<0.01
1,3,5-TRIMETHYLBENZENE	<0.001		
1,3-DICHLOROBENZENE	<0.001		
1,3-DICHLOROPROPANE	<0.001		
1,4-DICHLORO-2-BUTENE		<0.01	
1,4-DICHLOROBENZENE	<0.0005		
1,4-DIFLUOROBENZENE	<0.001	<0.01	
HEXACHLOROCYCLOHEPTANE	<0.001		
ISOPROPYLBENZENE	<0.001		
N-BUTYLBENZENE	<0.001		
N-PROPYLBENZENE	<0.001		
NAPHTHALENE	<0.001		
P-ISOPROPYLTOLUENE	<0.001		
SEC-BUTYLBENZENE	<0.001		
TERT-BUTYLBENZENE	<0.001		

-- HYDROCARBONS --

ORGANIC CARBON

-- OTHER PARAMETERS --

CYANIDE (CN)	<0.005	<0.005	<0.005
CYANIDE (CN) *TOT			
CHEMICAL OXYGEN DEMAND	3.0	10.0	14.0

* DIS - Dissolved
* TOT - Total

ALL quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

Sample Type: Private Well

	13		13		13		13		13		13		19		20		23	
	SITE CODE	02/16/90	05/04/90	09:30	EL	04/04/91	01/22/92	05/20/92	05/04/90	09:45	05/06/90	05/06/90	05/04/90	09:45	05/06/90	05/06/90	05/06/90	11:15
	SAMPLE DATE	09:30	09:30	09:30	EL	11:30	14:30	09:30	09:30	EL	09:30	09:30	09:45	EL	09:30	09:30	11:15	EL
	LAB	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL
	LAB NUMBER	90-3298	90-10822	90-10822	91-12763	91-12763	92-4692	92-19276	90-10823	90-10823	90-10825	90-10825	90-10823	90-10823	90-10825	90-10825	90-10826	90-10826
	SAMPLE NUMBER	HL-90-10	HL-9005-105	HL-9005-105	HL-9104-100	HL-9104-100	HL-9201-109	HL-9205-105	HL-9005-106	HL-9005-106	HL-9005-108	HL-9005-108	HL-9005-108	HL-9005-108	HL-9005-108	HL-9005-108	HL-9005-109	HL-9005-109
-- VOLATILE ORGANICS --																		
1,1,1,2-TETRACHLOROETHANE	<0.001	0.00078	<0.001	0.00079	<0.001	0.00088	0.001	0.0005	<0.001	<0.0005	<0.001	<0.001	<0.001	<0.0005	<0.001	<0.0005	<0.001	<0.001
1,1,1-TRICHLOROETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,1,2,2-TETRACHLOROETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,1,2-TRICHLOROETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,1-DICHLOROETHANE	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
1,1-DICHLOROPROPENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,2-DIBROMOETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,2-DICHLOROETHANE	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
1,2-DICHLOROPROPANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
2,2-DICHLOROPROPANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
2-BUTANONE (METHYL-ETHYL-KETONE)																		
2-CHLOROETHYL VINYL ETHER																		
2-CHLOROTOLUENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
2-HEXANONE																		
4-BROMOFLUOROBENZENE																		
4-CHLOROTOLUENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
4-METHYL-2-PENTANONE																		
ACETONE																		
ACROLEIN																		
ACRYLONITRILE																		
BENZENE	<0.0005	<0.001	<0.0005	<0.001	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
BROMOBENZENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
BROMOCHLOROMETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
BROMODICHLOROMETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
BROMOFORM	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
BROMOMETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
CARBON DISULFIDE																		
CARBON TETRACHLORIDE	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
CHLOROBENZENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
CHLOROETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
CHLOROFORM	0.0029	0.0044	0.0044	0.0044	0.0036	0.0036	0.0038	0.0024	0.0038	0.0038	0.0038	0.0038	0.0038	0.0038	0.0038	0.0038	0.0038	0.0038
CHLOROMETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
CIS-1,2-DICHLOROETHENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
CIS-1,3-DICHLOROPROPENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

* DIS - Dissolved
* TOT - Total

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

APPENDIX A - SUMMARY OF WATER QUALITY ANALYSES
CHL01 - City of Helena - Helena Landfill Mtnng

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08/19/92

Sample Type: Private Well

	13				13				13				19				20				23			
	SITE CODE	DATE	TIME	LAB	SITE CODE	DATE	TIME	LAB	SITE CODE	DATE	TIME	LAB	SITE CODE	DATE	TIME	LAB	SITE CODE	DATE	TIME	LAB	SITE CODE	DATE	TIME	LAB
	02/16/90	09:30	EL	90-3298	05/04/90	09:30	EL	90-10822	06/04/91	11:30	EL	91-12763	05/20/92	09:45	EL	90-10823	05/06/90	11:10	EL	90-10825	05/06/90	11:15	EL	90-10826
	HL-90-10			HL-90-10	HL-9005-105			HL-9005-105	HL-9104-100			HL-9201-109	HL-9205-105			HL-9005-106	HL-9005-108			HL-9005-109				
--- VOLATILE ORGANICS ---																								
DIBROMOCHLOROMETHANE	<0.001				<0.001				<0.001				<0.001				<0.001				<0.001			
DIBROMOMETHANE	<0.001				<0.001				<0.001				<0.001				<0.001				<0.001			
DICHLORODIFLUOROMETHANE	0.0043				0.0023				0.0024				0.0021				<0.001				<0.001			
ETHANOL									<0.01															
ETHYL METHACRYLATE	<0.001				<0.001				<0.01				<0.01				<0.001				<0.001			
ETHYLBENZENE	<0.001				<0.001				<0.001				<0.001				<0.001				<0.001			
IODOMETHANE									<0.01				<0.01											
XYLENE									<0.001				<0.001											
m-XYLENE	<0.001				<0.001				<0.001				<0.001				<0.001				<0.001			
o-XYLENE	<0.001				<0.001				<0.001				<0.001				<0.001				<0.001			
p-XYLENE	<0.001				<0.001				<0.001				<0.001				<0.001				<0.001			
METHYLENE CHLORIDE	<0.001				<0.001				<0.001				<0.001				<0.001				<0.001			
STYRENE	<0.001				<0.001				<0.001				<0.001				<0.001				<0.001			
TETRACHLOROETHENE	0.0027				0.0023				0.0034				0.0037				<0.005				<0.005			
TOLUENE	<0.001				<0.001				<0.001				<0.001				<0.001				<0.001			
TRANS-1,2-DICHLOROETHENE	<0.001				<0.001				<0.001				<0.001				<0.001				<0.001			
TRANS-1,3-DICHLOROPROPENE	<0.001				<0.001				<0.001				<0.001				<0.001				<0.001			
TRICHLOROETHENE	<0.005				0.00074				0.0005				0.00054				<0.005				<0.005			
TRICHLOROFLUOROMETHANE	<0.001				<0.001				<0.001				0.0012				<0.001				<0.001			
VINYL ACETATE					<0.001				<0.01				<0.01				<0.005				<0.005			
VINYL CHLORIDE	<0.005				<0.005				<0.005				<0.005				<0.005				<0.005			
--- SEMI-VOLATILE EXTRACTABLES ---																								
1,2,3-TRICHLOROBENZENE	<0.001				<0.001				<0.001				<0.001				<0.001				<0.001			
1,2,3-TRICHLOROPROPANE	<0.001				<0.001				<0.001				<0.001				<0.001				<0.001			
1,2,4-TRICHLOROBENZENE	<0.001				<0.001				<0.001				<0.001				<0.001				<0.001			
1,2,4-TRIMETHYLBENZENE	<0.001				<0.001				<0.001				<0.001				<0.001				<0.001			
1,2-DIBROMO-3-CHLOROPROPANE	<0.001				<0.001				<0.001				<0.001				<0.001				<0.001			
1,2-DICHLOROBENZENE	<0.001				<0.001				<0.001				<0.001				<0.001				<0.001			
1,3,5-TRIMETHYLBENZENE	<0.001				<0.001				<0.001				<0.001				<0.001				<0.001			
1,3-DICHLOROBENZENE	<0.001				<0.001				<0.001				<0.001				<0.001				<0.001			
1,3-DICHLOROPROPANE	<0.001				<0.001				<0.001				<0.001				<0.001				<0.001			
1,4-DICHLORO-2-BUTENE	<0.001				<0.001				<0.01				<0.01				<0.001				<0.001			
1,4-DICHLOROBENZENE	<0.005				<0.005				<0.01				<0.01				<0.005				<0.005			
1,4-DIFLUOROBENZENE																								

* DIS - Dissolved
* TOT - Total

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

Sample Type: Private Well

SITE CODE	13	13	13	13	13	19	20
SAMPLE DATE	02/16/90	05/04/90	04/04/91	01/22/92	05/20/92	05/04/90	05/06/90
SAMPLE TIME	09:30	09:30	11:30	14:30	09:30	09:45	11:15
LAB	EL	EL	EL	EL	EL	EL	EL
LAB NUMBER	90-3298	90-10822	91-12763	92-4692	92-19276	90-10823	90-10826
SAMPLE NUMBER	HL-90-10	HL-9005-105	HL-9104-100	HL-9201-109	HL-9205-105	HL-9005-106	HL-9005-109
-- SEMI-VOLATILE EXTRACTABLES --							
DICHLOROMONOFLUOROMETHANE	0.001	<0.0019				<0.001	0.0045
HEXACHLOROBUTADIENE	<0.001	<0.001				<0.001	<0.001
ISOPROPYLBENZENE	<0.001	<0.001				<0.001	<0.001
N-BUTYLBENZENE	<0.001	<0.001				<0.001	<0.001
N-PROPYLBENZENE	<0.001	<0.001				<0.001	<0.001
NAPHTHALENE	<0.001	<0.001				<0.001	<0.001
P-ISOPROPYLTOLUENE	<0.001	<0.001				<0.001	<0.001
SEC-BUTYLBENZENE	<0.001	<0.001				<0.001	<0.001
TERT-BUTYLBENZENE	<0.001	<0.001				<0.001	<0.001

* DIS - Dissolved
* TOT - Total

ALL quantities in mg/L (water) or mg/kg (soil) unless otherwise noted. ALL results are LABORATORY unless otherwise specified as field (FLD). Blank line indicates parameter not tested.

APPENDIX A - SUMMARY OF WATER QUALITY ANALYSES
CHL01 - City of Helena - Hlna Landfill Mtrng

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Sample Type: Private Well

	26		28		31		31		31		32		34	
	SITE CODE	05/03/90	06/05/90	05/03/90	04/13/91	01/29/92	05/28/92	05/03/90	05/06/90	05/03/90	05/06/90	05/06/90	05/06/90	05/06/90
	SAMPLE TIME	11:00	10:30	12:50	13:20	17:20	EL	EL	EL	EL	EL	EL	EL	EL
	LAB	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL
	LAB NUMBER	90-10817	90-15038	90-10820	91-13088	92-5002	92-19788	92-5002	92-5002	92-5002	92-5002	92-5002	92-5002	92-5002
	SAMPLE NUMBER	HL-9005-100	HL-9006-100	HL-9005-103	HL-9104-111	HL-9201-110	HL-9205-112	HL-9201-110	HL-9201-110	HL-9201-110	HL-9201-110	HL-9201-110	HL-9201-110	HL-9201-110
-- VOLATILE ORGANICS --														
1,1,1,2-TETRACHLOROETHANE	<0.001	<0.005	<0.001	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1,1-TRICHLOROETHANE	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1,2,2-TETRACHLOROETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,1,2-TRICHLOROETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,1-DICHLOROETHANE	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1-DICHLOROPROPENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,2-DIBROMOETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,2-DICHLOROETHANE	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,2-DICHLOROPROPANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
2,2-DICHLOROPROPANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
2-BUTANONE (METHYL-ETHYL-KETONE)														
2-CHLOROETHYL VINYL ETHER														
2-CHLOROTOLUENE	<0.001	<0.001	<0.001	<0.001	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
2-HEXANONE														
4-BROMOFLUOROBENZENE														
4-CHLOROTOLUENE	<0.001	<0.001	<0.001	<0.001	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
4-METHYL-2-PENTANONE														
ACETONE														
ACROLEIN														
ACRYLONITRILE														
BENZENE	<0.005	<0.001	<0.005	<0.001	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
BROMOBENZENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
BROMOCHLOROMETHANE	<0.001	<0.001	0.0019	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
BROMODICHLOROMETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
BROMOFORM	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
BROMOMETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
CARBON DISULFIDE														
CARBON TETRACHLORIDE	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
CHLOROBENZENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
CHLOROETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
CHLOROFORM	<0.001	<0.001	0.014	<0.001	0.0077	0.0088	0.009	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
CHLOROMETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
CIS-1,2-DICHLOROETHENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
CIS-1,3-DICHLOROPROPENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
* DIS - Dissolved														
* TOT - Total														

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

APPENDIX A - SUMMARY OF WATER QUALITY ANALYSES
CHL01 - City of Helena - Helena Landfill Mtnng

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08/19/92

Sample Type: Private Well

SITE CODE	26	28	31	31	31	31	32	34
SAMPLE DATE	05/03/90	06/05/90	05/03/90	04/13/91	01/29/92	05/28/92	05/03/90	05/06/90
SAMPLE TIME	11:00	10:30	12:50	13:20	17:20	EL	11:40	EL
LAB	EL	EL	EL	EL	EL	EL	EL	EL
LAB NUMBER	90-10817	90-15038	90-10820	91-13088	92-5002	92-19788	90-10818	90-10824
SAMPLE NUMBER	HL-9005-100	HL-9006-100	HL-9005-103	HL-9104-111	HL-9201-110	HL-9205-112	HL-9005-101	HL-9005-107
-- VOLATILE ORGANICS --								
DIBROMOCHLOROMETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
DIBROMOMETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
DICHLOROFLUOROMETHANE	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.001	<0.001
ETHANOL								
ETHYL METHACRYLATE	<0.001	<0.001	<0.001	<0.01	<0.01	<0.01	<0.001	<0.001
ETHYLBENZENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
IODOETHANE	<0.001	<0.001	<0.001	<0.01	<0.01	<0.01	<0.001	<0.001
XYLENE								
M-XYLENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
O-XYLENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
P-XYLENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
METHYLENE CHLORIDE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
STYRENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
TETRACHLOROETHENE	<0.0005	0.0074	0.0006	<0.0005	<0.0005	<0.0005	<0.0005	0.0022
TOLUENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
TRANS-1,2-DICHLOROETHENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
TRANS-1,3-DICHLOROPROPENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
TRICHLOROETHENE	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
TRICHLOROFLUOROMETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
VINYL ACETATE	<0.001	<0.001	<0.001	<0.01	<0.01	<0.01	<0.001	<0.001
VINYL CHLORIDE	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
-- SEMI-VOLATILE EXTRACTABLES --								
1,2,3-TRICHLOROBENZENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,2,3-TRICHLOROPROPANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,2,4-TRICHLOROBENZENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,2,4-TRIMETHYLBENZENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,2-DIBROMO-3-CHLOROPROPANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,2-DICHLOROBENZENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,3,5-TRIMETHYLBENZENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,3-DICHLOROBENZENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,3-DICHLOROPROPANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,4-DICHLORO-2-BUTENE	<0.001	<0.001	<0.001	<0.01	<0.01	<0.01	<0.001	<0.001
1,4-DICHLOROBENZENE	<0.001	<0.001	<0.001	<0.01	<0.01	<0.01	<0.001	<0.001
1,4-DIFLUOROBENZENE	<0.0005	<0.0005	<0.0005	<0.01	<0.01	<0.01	<0.0005	<0.0005

* DIS - Dissolved
* TOT - Total

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

APPENDIX A - SUMMARY OF WATER QUALITY ANALYSES
OHL01 - City of Helena - Helena Landfill Mtnrg

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Sample Type: Private Well

SITE CODE 26
SAMPLE DATE 05/03/90
SAMPLE TIME 11:00
LAB EL
LAB NUMBER 90-10817
SAMPLE NUMBER HL-9005-100

28
06/05/90
10:30
EL
90-15038
HL-9006-100

31
05/03/90
12:50
EL
90-10820
HL-9005-103

31
04/13/91
13:20
EL
91-13088
HL-9104-111

31
01/29/92
17:20
EL
92-5002
HL-9201-110

31
05/28/92
EL
92-19788
HL-9205-112

32
05/03/90
11:40
EL
90-10818
HL-9005-101

34
05/06/90
11:00
EL
90-10824
HL-9005-107

-- SEMI-VOLATILE EXTRACTABLES --

DICHLORODIFLUOROMETHANE

HEXACHLOROCYCLOPENTADIENE

ISOPROPYLBENZENE

N-BUTYLBENZENE

N-PROPYLBENZENE

NAPHTHALENE

P-ISOPROPYLTOLUENE

SEC-BUTYLBENZENE

TERT-BUTYLBENZENE

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* DIS - Dissolved

* TOT - Total

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

APPENDIX A - SUMMARY OF WATER QUALITY ANALYSES
CHL01 - City of Helena - Helena Landfill Mtnng

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Sample Type: Private Well

SITE CODE	36	38	38	38	40	40	40	42
SAMPLE DATE	06/05/90	05/03/90	05/03/90	01/22/92	05/06/90	04/13/91	05/28/92	05/03/90
SAMPLE TIME	11:00	13:10	13:40	14:15	12:15	13:40	EL	12:20
LAB	EL	EL	EL	EL	EL	EL	EL	EL
LAB NUMBER	90-15040	90-10821	90-10833	92-4691	90-10831	91-13086	92-19787	90-10819
REMARKS			DUPLICATE					
SAMPLE NUMBER	HL-9006-102	HL-9005-104	HL-9005-204	HL-9201-108	HL-9005-114	HL-9104-109	HL-9205-118	HL-9005-102
-- VOLATILE ORGANICS --								
1,1,1,2-TETRACHLOROETHANE	<0.001	<0.001	<0.001	<0.0005	<0.001	0.001	0.001	<0.001
1,1,1-TRICHLOROETHANE	<0.005	<0.005	<0.005	<0.001	0.0013	0.001	0.001	0.00089
1,1,2,2-TETRACHLOROETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,1,2-TRICHLOROETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,1-DICHLOROETHANE	<0.001	<0.001	<0.001	<0.001	0.0015	0.0012	0.0013	<0.001
1,1-DICHLOROETHENE	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1-DICHLOROPROPENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,2-DIBROMOETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,2-DICHLOROETHANE	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,2-DICHLOROPROPANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
2,2-DICHLOROPROPANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
2-BUTANONE (METHYL-ETHYL-KETONE)								
2-CHLOROETHYL VINYL ETHER								
2-CHLOROTOLUENE	<0.001	<0.001	<0.001	<0.01	<0.001	<0.01	<0.01	<0.001
2-HEXANONE								
4-BROMOFLUOROBENZENE								
4-CHLOROTOLUENE	<0.001	<0.001	<0.001	<0.01	<0.001	<0.01	<0.01	<0.001
4-METHYL-2-PENTANONE								
ACETONE								
ACROLEIN								
ACRYLONITRILE								
BENZENE	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
BROMOBENZENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
BROMOCHLOROMETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
BROMODICHLOROMETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
BROMOFORM	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
BROMOMETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
CARBON DISULFIDE								
CARBON TETRACHLORIDE	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
CHLOROBENZENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
CHLOROETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
CHLOROFORM	<0.001	0.009	0.0079	0.0074	0.011	0.011	0.0091	0.0028
CHLOROMETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
CIS-1,2-DICHLOROETHENE	<0.001	<0.001	<0.001	<0.001	0.002	<0.001	<0.001	<0.001

* DIS - Dissolved
* TOT - Total

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

Sample Type: Private Well

SITe CODE	36	38	38	38	40	40	40	42
SAMPLE DATE	06/05/90	05/03/90	05/03/90	01/22/92	05/06/90	04/13/91	05/28/92	05/03/90
SAMPLE TIME	11:00	13:10	13:40	14:15	12:15	13:40		12:20
LAB	EL	EL	EL	EL	EL	EL	EL	EL
LAB NUMBER	90-15040	90-10821	90-10833	92-4691	90-10831	91-13086	92-19787	90-10819
REMARKS			DUPLICATE					
SAMPLE NUMBER	HL-9006-102	HL-9005-104	HL-9005-204	HL-9201-108	HL-9005-114	HL-9104-109	HL-9205-118	HL-9005-102
-- VOLATILE ORGANICS --								
CIS-1,3-DICHLOROPROPENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
DIBROMOCHLOROMETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
DIBROMOMETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
DICHLORODIFLUOROMETHANE	<0.001	<0.001	0.001	<0.001	0.0045	0.0021	0.0014	0.0046
ETHANOL						<0.01	<0.01	
ETHYL METHACRYLATE				<0.01		<0.01	<0.01	
ETHYLBENZENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
IODOETHANE				<0.01		<0.01	<0.01	
XYLENE				<0.001		<0.001	<0.001	
M-XYLENE	<0.001	<0.001	<0.001		<0.001			<0.001
O-XYLENE	<0.001	<0.001	<0.001		<0.001			<0.001
P-XYLENE	<0.001	<0.001	<0.001		<0.001			<0.001
METHYLENE CHLORIDE	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001
STYRENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
TETRACHLOROETHENE	<0.005	0.0011	0.00097	0.00074	0.008	0.0056	0.0046	0.005
TOLUENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
TRANS-1,2-DICHLOROETHENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
TRANS-1,3-DICHLOROPROPENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
TRICHLOROETHENE	<0.005	<0.005	<0.005	<0.005	0.0013	0.00088	0.001	0.0005
TRICHLOROFUOROMETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0011	<0.001
VINYL ACETATE				<0.01		<0.01	<0.01	
VINYL CHLORIDE	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
-- SEMI-VOLATILE EXTRACTABLES --								
1,2,3-TRICHLOROBENZENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,2,3-TRICHLOROPROPANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,2,4-TRICHLOROBENZENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,2,4-TRIMETHYLBENZENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,2-DIBROMO-3-CHLOROPROPANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,2-DICHLOROBENZENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,3,5-TRIMETHYLBENZENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,3-DICHLOROBENZENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,3-DICHLOROPROPANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,4-DICHLORO-2-BUTENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

* DIS - Dissolved
* TOT - Total

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

[illegible][illegible]

* DIS - Dissolved
* TOT - Total

ALL quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. ALL results are LABORATORY unless otherwise specified as field (FLD). Blank line indicates parameter not tested.

Sample Type: Private Well

	47		48		48		5		51		52	
	SITE CODE	01/22/92	06/01/90	05/20/92	06/01/90	05/20/92	04/13/91	06/01/90	06/01/90	04/13/91	05/28/92	EL
	SAMPLE TIME	13:05	13:30	11:30	13:30	11:30	13:00	13:50	13:50	13:30	EL	EL
	LAB	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL
	LAB NUMBER	92-4689	90-14925	92-19279	90-14925	92-19279	91-13087	90-14926	91-12765	91-12765	92-19789	92-19789
	SAMPLE NUMBER	HL-9201-106	HL-0690-200	HL-9205-110	HL-0690-200	HL-9205-110	HL-9104-110	HL-0690-201	HL-9104-102	HL-9104-102	HL-9205-114	HL-9205-114
-- VOLATILE ORGANICS --												
1,1,1,2-TETRACHLOROETHANE		0.00061	<0.001	0.00054	0.00067	<0.001	<0.0005	<0.001	0.00054	0.0006	0.00096	
1,1,1-TRICHLOROETHANE		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	
1,1,2,2-TETRACHLOROETHANE		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	
1,1,2-TRICHLOROETHANE		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	
1,1-DICHLOROETHANE		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	
1,1-DICHLOROPROPENE			<0.001		<0.001	<0.001		<0.001	<0.001			
1,2-DIBROMOETHANE			<0.001		<0.001	<0.001		<0.001	<0.001			
1,2-DICHLOROETHANE		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	
1,2-DICHLOROPROPANE			<0.001		<0.001	<0.001		<0.001	<0.001			
2,2-DICHLOROPROPANE			<0.001		<0.001	<0.001		<0.001	<0.001			
2-BUTANONE (METHYL-ETHYL-KETONE)												
2-CHLOROETHYL VINYL ETHER		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
2-CHLOROTOLUENE												
2-HEXANONE												
4-BROMOFLUOROBENZENE		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
4-CHLOROTOLUENE												
4-METHYL-2-PENTANONE												
ACETONE												
ACROLEIN												
ACRYLONITRILE		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	
BENZENE												
BROMOBENZENE		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	
BROMOCHLOROMETHANE		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	
BROMODICHLOROMETHANE		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	
BROMOFORM		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	
BROMOMETHANE		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	
CARBON DISULFIDE												
CARBON TETRACHLORIDE		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	
CHLOROBENZENE		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	
CHLOROETHANE		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	
CHLOROFORM		0.0032	0.0016	0.0015	0.0016	0.0015	0.0023	0.0023	0.0023	0.0043	0.007	
CHLOROMETHANE		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	
CIS-1,2-DICHLOROETHENE												
CIS-1,3-DICHLOROPROPENE		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	

* DIS - Dissolved
* TOT - Total

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank Line indicates parameter not tested.

APPENDIX A - SUMMARY OF WATER QUALITY ANALYSES
OHL01 - City of Helena - HUna Landfill Mtrng

Sample Type: Private Well

SITE CODE	47	48	48	5	51	52
SAMPLE DATE	01/22/92	05/20/92	06/01/90	04/13/91	06/01/90	04/04/91
SAMPLE TIME	13:05	11:30	13:30	13:00	13:50	13:30
LAB	EL	EL	EL	EL	EL	EL
LAB NUMBER	92-4689	92-19279	90-14925	91-13087	90-14926	91-12765
SAMPLE NUMBER	HL-9201-106	HL-9205-110	HL-0690-200	HL-9104-110	HL-0690-201	HL-9104-102

-- VOLATILE ORGANICS --

DIBROMOCHLOROMETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
DIBROMOMETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
DICHLOROFLUOROMETHANE	0.001	0.0011	0.001	<0.001	0.0018	0.0031
ETHANOL				<0.01		
ETHYL METHACRYLATE	<0.01	<0.01		<0.01		<0.01
ETHYLBENZENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
IODOMETHANE	<0.01	<0.01		<0.01		<0.01
XYLENE	<0.001	<0.001		<0.001		<0.001
M-XYLENE			<0.001		<0.001	
O-XYLENE			<0.001		<0.001	
P-XYLENE			<0.001		<0.001	
METHYLENE CHLORIDE	<0.001	<0.001		<0.001		<0.001
STYRENE	<0.001	<0.001				
TETRACHLOROETHENE	0.0013	0.0013	0.0017	0.0005	<0.0017	0.0022
TOLUENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
TRANS-1,2-DICHLOROETHENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
TRANS-1,3-DICHLOROPROPENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
TRICHLOROETHENE	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
TRICHLOROFLUOROMETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
VINYL ACETATE	<0.01	<0.01		<0.01	<0.005	0.0018
VINYL CHLORIDE	<0.0005	<0.0005		<0.0005		<0.0005

-- SEMI-VOLATILE EXTRACTABLES --

1,2,3-TRICHLOROBENZENE						
1,2,3-TRICHLOROPROPANE						
1,2,4-TRICHLOROBENZENE	<0.001	<0.001		<0.001		<0.001
1,2,4-TRIMETHYLBENZENE						
1,2-DIBROMO-3-CHLOROPROPANE						
1,2-DICHLOROBENZENE						
1,3,5-TRIMETHYLBENZENE						
1,3-DICHLOROBENZENE						
1,3-DICHLOROPROPANE						
1,4-DICHLORO-2-BUTENE						
1,4-DICHLOROBENZENE				<0.01		
1,4-DIFLUOROBENZENE	<0.01	<0.01		<0.01		<0.01

* DIS - Dissolved
* TOT - Total

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

Sample Type: Private Well

SITE CODE 47
SAMPLE DATE 01/22/92
SAMPLE TIME 13:05
LAB EL
LAB NUMBER 92-4689
SAMPLE NUMBER HL-9201-106

48
06/01/90
13:30
EL
90-14925
HL-0690-200

5
04/13/91
13:00
EL
91-13087
HL-9104-110

51
06/01/90
13:30
EL
90-14926
HL-0690-201

52
04/04/91
13:30
EL
91-12765
HL-9104-102

52
05/28/92
EL
92-19789
HL-9205-114

— SEMI-VOLATILE EXTRACTABLES —
DICHLOROMONOFUOROMETHANE
HEXACHLOROBUTADIENE
ISOPROPYLBENZENE
N-BUTYLBENZENE
N-PROPYLBENZENE
NAPHTHALENE
P-ISOPROPYLTOLUENE
SEC-BUTYLBENZENE
TERT-BUTYLBENZENE

<0.001
<0.001
<0.001
<0.001
<0.001
<0.001
<0.001
<0.001
<0.001
<0.001

* DIS - Dissolved
* TOT - Total

ALL quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. ALL results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

APPENDIX A - SUMMARY OF WATER QUALITY ANALYSES
04HLO1 - City of Helena - Helena Landfill Mtnmg

Sample Type: Private Well

[illegible]

* DIS - Dissolved
* TOT - Total

ALL quantities in mg/L (water) or mg/kg (soil) unless otherwise noted. ALL results are LABORATORY unless otherwise specified as field (FLD). Blank line indicates parameter not tested.

APPENDIX A - SUMMARY OF WATER QUALITY ANALYSES
CHL01 - City of Helena - HUna Landfill Mtrng

Page: 38
08/19/92

Sample Type: Private Well

SITe CODE	SAMPLE DATE	SAMPLE TIME	LAB	LAB NUMBER	REMARKS	SAMPLE NUMBER	59				67	67	68	75	75
							06/01/90	04/04/91	01/22/92	05/20/92	06/01/90	06/01/90	04/04/91	01/22/92	05/20/92
			EL	14:50		HL-0690-202	14:50	14:00	11:40	10:20	16:05	16:00	12:30	13:30	10:45
			EL	90-14927		HL-0690-202	90-14927	91-12766	92-4688	92-19277	90-14928	90-14929	91-12764	92-4690	92-19278
						HL-0690-202					DEEP	SHALLOW			
						HL-0690-202		HL-9104-103	HL-9201-105	HL-9205-102	HL-0690-203	HL-0690-204	HL-9104-101	HL-9201-107	HL-9205-100
VOLATILE ORGANICS --															
CIS-1,3-DICHLOROPROPENE							<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
DIBROMOCHLOROMETHANE							<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
DIBROMOMETHANE							<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
DICHLORODIFLUOROMETHANE							0.0013	0.0024	0.0018	0.0026	<0.001	<0.001	<0.001	<0.001	<0.001
ETHANOL								<0.01					<0.01		
ETHYL METHACRYLATE							<0.01	<0.01	<0.01	<0.01	<0.001	<0.001	<0.01	<0.01	<0.01
ETHYLBENZENE							<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
IODOMETHANE								<0.01	<0.01	<0.01			<0.01	<0.01	<0.01
XYLENE							<0.001	<0.001	<0.001	<0.001			<0.001	<0.001	<0.001
M-XYLENE							<0.001				<0.001	<0.001		<0.01	<0.01
O-XYLENE							<0.001				<0.001	<0.001		<0.001	<0.001
P-XYLENE							<0.001				<0.001	<0.001		<0.001	<0.001
METHYLENE CHLORIDE							<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		<0.001	<0.001
STYRENE							<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		<0.001	<0.001
TETRACHLOROETHENE							0.0011	0.0013	0.0016	0.0015	<0.0005	0.00064		<0.0005	<0.0005
TOLUENE							<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
TRANS-1,2-DICHLOROETHENE							<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
TRANS-1,3-DICHLOROPROPENE							<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
TRICHLOROETHENE							<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
TRICHLOROFUOROMETHANE							<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
VINYL ACETATE							<0.001	<0.01	<0.01	<0.01	<0.001	<0.001	<0.01	<0.01	<0.01
VINYL CHLORIDE							<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
SEMI-VOLATILE EXTRACTABLES --															
1,2,3-TRICHLOROBENZENE							<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,2,3-TRICHLOROPROPANE							<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,2,4-TRICHLOROBENZENE							<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,2,4-TRIMETHYLBENZENE							<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,2-DIBROMO-3-CHLOROPROPANE							<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,2-DICHLOROBENZENE							<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,3,5-TRIMETHYLBENZENE							<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,3-DICHLOROBENZENE							<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,3-DICHLOROPROPANE							<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,4-DICHLORO-2-BUTENE							<0.001	<0.01			<0.001	<0.001	<0.01	<0.01	<0.005

* DIS - Dissolved
* TOT - Total

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank Line indicates parameter not tested.

APPENDIX A - SUMMARY OF WATER QUALITY ANALYSES
OHL01 - City of Helena - Helena Landfill Mtnng

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08/19/92

Sample Type: Private Well

SITE CODE	59	59	59	59	59	67	67	68	75	75
SAMPLE DATE	06/01/90	04/04/91	01/22/92	05/20/92	01/22/92	06/01/90	06/01/90	04/04/91	01/22/92	01/22/92
SAMPLE TIME	14:50	14:00	11:40	10:20	11:40	16:00	16:00	12:00	13:30	13:30
LAB	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL
LAB NUMBER	90-14927	91-12766	92-4688	92-19277	92-4688	90-14929	90-14929	91-12764	92-4690	92-4690
REMARKS						SHALLOW	SHALLOW			
SAMPLE NUMBER	HL-0690-202	HL-9104-103	HL-9201-105	HL-9205-102	HL-9201-105	HL-0690-203	HL-0690-204	HL-9104-101	HL-9201-107	HL-9205-100
-- SEMI-VOLATILE EXTRACTABLES --										
1,4-DICHLOROBENZENE	<0.0005	<0.01	<0.01	<0.01	<0.01	<0.0005	<0.0005	<0.01	<0.01	<0.01
1,4-DIFLUOROBENZENE	<0.001					<0.001	<0.001			
DICHLOROMONOFLUOROMETHANE	<0.001					<0.001	<0.001			
HEXACHLOROBUTADIENE	<0.001					<0.001	<0.001			
ISOPROPYLBENZENE	<0.001					<0.001	<0.001			
N-BUTYLBENZENE	<0.001					<0.001	<0.001			
N-PROPYLBENZENE	<0.001					<0.001	<0.001			
NAPHTHALENE	<0.001					<0.001	<0.001			
P-ISOPROPYLTOLUENE	<0.001					<0.001	<0.001			
SEC-BUTYLBENZENE	<0.001					<0.001	<0.001			
TERT-BUTYLBENZENE	<0.001					<0.001	<0.001			

* DIS - Dissolved

* TOT - Total

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

Sample Type: Private Well

SITE CODE 84
SAMPLE DATE 06/06/90
SAMPLE TIME 12:45
LAB EL
LAB NUMBER 90-15044
SAMPLE NUMBER HL-9006-106

--- VOLATILE ORGANICS ---

1,1,1,2-TETRACHLOROETHANE	<0.001	<0.001
1,1,1-TRICHLOROETHANE	<0.005	<0.005
1,1,2,2-TETRACHLOROETHANE	<0.001	<0.001
1,1,2-TRICHLOROETHANE	<0.001	<0.001
1,1-DICHLOROETHANE	<0.001	<0.001
1,1-DICHLOROETHENE	<0.005	<0.005
1,1-DICHLOROPROPENE	<0.001	<0.001
1,2-DIBROMOETHANE	<0.001	<0.001
1,2-DICHLOROETHANE	<0.005	<0.005
1,2-DICHLOROPROPANE	<0.001	<0.001
2,2-DICHLOROPROPANE	<0.001	<0.001
2-CHLOROTOLUENE	<0.001	<0.001
4-CHLOROTOLUENE	<0.001	<0.001
BENZENE	<0.005	<0.005
BROMOBENZENE	<0.001	<0.001
BROMOCHLOROMETHANE	<0.001	<0.001
BROMODICHLOROMETHANE	<0.001	<0.001
BROMOFORM	<0.001	<0.001
BROMOMETHANE	<0.001	<0.001
CARBON TETRACHLORIDE	<0.005	<0.005
CHLOROBENZENE	<0.001	<0.001
CHLOROETHANE	<0.001	<0.001
CHLOROFORM	<0.001	<0.001
CHLOROMETHANE	<0.001	<0.001
CIS-1,2-DICHLOROETHENE	<0.001	<0.001
CIS-1,3-DICHLOROPROPENE	<0.001	<0.001
DIBROMOCHLOROMETHANE	<0.001	<0.001
DIBROMOMETHANE	<0.001	<0.001
DICHLORODIFLUOROMETHANE	<0.001	<0.001
ETHYLBENZENE	<0.001	<0.001
H-XYLENE	<0.001	<0.001
O-XYLENE	<0.001	<0.001
P-XYLENE	<0.001	<0.001
METHYLENE CHLORIDE	<0.001	<0.001
STYRENE	<0.001	<0.001

* DIS - Dissolved
* TOT - Total

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank Line indicates parameter not tested.

Sample Type: Private Well

SITE CODE 84
SAMPLE DATE 06/06/90
SAMPLE TIME 12:45
LAB EL
LAB NUMBER 90-15044
SAMPLE NUMBER HL-9006-106

-- VOLATILE ORGANICS --

TETRACHLOROETHENE	<0.0005	<0.0005
TOLUENE	<0.001	<0.001
TRANS-1,2-DICHLOROETHENE	<0.001	<0.001
TRANS-1,3-DICHLOROPROPENE	<0.001	<0.001
TRICHLOROETHENE	<0.0005	<0.0005
TRICHLOROFLUOROMETHANE	<0.001	<0.001
VINYL CHLORIDE	<0.0005	<0.0005

-- SEMI-VOLATILE EXTRACTABLES --

1,2,3-TRICHLOROBENZENE	<0.001	<0.001
1,2,3-TRICHLOROPROPANE	<0.001	<0.001
1,2,4-TRICHLOROBENZENE	<0.001	<0.001
1,2,4-TRIMETHYLBENZENE	<0.001	<0.001
1,2-DIBROMO-3-CHLOROPROPANE	<0.001	<0.001
1,2-DICHLOROBENZENE	<0.001	<0.001
1,3,5-TRIMETHYLBENZENE	<0.001	<0.001
1,3-DICHLOROBENZENE	<0.001	<0.001
1,3-DICHLOROPROPANE	<0.001	<0.001
1,4-DICHLOROBENZENE	<0.0005	<0.0005
DICHLOROMONOFUOROMETHANE	<0.001	<0.001
HEXACHLOROBUTADIENE	<0.001	<0.001
ISOPROPYLBENZENE	<0.001	<0.001
N-BUTYLBENZENE	<0.001	<0.001
N-PROPYLBENZENE	<0.001	<0.001
NAPHTHALENE	<0.001	<0.001
P-ISOPROPYLTOLUENE	<0.001	<0.001
SEC-BUTYLBENZENE	<0.001	<0.001
TERT-BUTYLBENZENE	<0.001	<0.001

* DIS - Dissolved
* TOT - Total

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

APPENDIX A - SUMMARY OF WATER QUALITY ANALYSES
OHL01 - City of Helena - Hura Landfill Htrmg

Sample Type: Quality Control

SITE CODE	D.I. BLANK	RINSBLANK
SAMPLE DATE	01/22/92	05/19/92
SAMPLE TIME	08:30	14:00
LAB	EL	EL
LAB NUMBER	92-4685	92-19271
SAMPLE NUMBER	HL-9201-102	HL-9205-107

-- PHYSICAL PARAMETERS --

SC (UMHOS/CH @25 C)	5.4	6.5
TDS (@ 180 C)	2.0	11.0
TOTAL SUSPENDED SOLIDS	<1.0	<1.0

-- COMMON IONS --

CALCIUM (CA) (DIS)	<1.0	<1.0
MAGNESIUM (MG) (DIS)	<1.0	<1.0
SODIUM (NA) (DIS)	<1.0	<1.0
POTASSIUM (K) (DIS)	<1.0	<1.0
TOTAL ALKALINITY AS CaCO3	2.0	5.0
BICARBONATE (HCO3)	2.0	6.0
CARBONATE AS CO3	0.0	0.0
SULFATE (SO4)	<1.0	<1.0
CHLORIDE (CL)	<1.0	<1.0

-- NUTRIENTS --

AMMONIA (NH3 AS N)	<0.1	<0.1
NITRATE (NO3-N)	<0.05	<0.05
NITRATE + NITRITE AS N	<0.05	<0.05

-- TRACE ELEMENTS --

ARSENIC (AS) *DIS	<0.005	<0.005
BARIUM (BA) *DIS	<0.1	<0.1
CADMIUM (CD) *DIS	<0.001	<0.001
CHROMIUM (CR) *DIS	<0.02	<0.01
IRON (FE) *DIS	<0.03	<0.03
LEAD (PB) *DIS	<0.01	<0.01
MANGANESE (MN) *DIS	<0.02	<0.02
MERCURY (HG) *DIS	<0.001	<0.001
SELENIUM (SE) *DIS	<0.005	<0.005
SILVER (AG) *DIS	<0.005	<0.005

-- VOLATILE ORGANICS --

1,1,1-TRICHLOROETHANE	0.00057	0.00054
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* DIS - Dissolved
* TOT - Total

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

Sample Type: Quality Control

SITE CODE D.I. BLANK
SAMPLE DATE 01/22/92
SAMPLE TIME 08:30
LAB EL
LAB NUMBER 92-4685
SAMPLE NUMBER HL-9201-102
RINSBLANK
05/19/92
14:00
EL
92-19271
HL-9205-107

-- VOLATILE ORGANICS --

1,1,2,2-TETRACHLOROETHANE	<0.001	<0.001
1,1,2-TRICHLOROETHANE	<0.001	<0.001
1,1-DICHLOROETHANE	<0.001	<0.001
1,1-DICHLOROETHENE	<0.0005	<0.0005
1,2-DICHLOROETHANE	<0.0005	<0.0005
2-CHLOROETHYL VINYL ETHER	<0.01	<0.01
4-BROMOFLUOROBENZENE	<0.01	<0.01
BENZENE	<0.0005	0.00058
BROMOCHLOROMETHANE	<0.001	<0.001
BROMODICHLOROMETHANE	<0.001	<0.001
BROMOFORM	<0.001	<0.001
BROMOMETHANE	<0.001	<0.001
CARBON TETRACHLORIDE	<0.0005	<0.0005
CHLOROBENZENE	<0.001	<0.001
CHLOROETHANE	<0.001	<0.001
CHLOROFORM	<0.001	<0.001
CHLOROMETHANE	<0.001	<0.001
CIS-1,3-DICHLOROPROPENE	<0.001	<0.001
DIBROMOCHLOROMETHANE	<0.001	<0.001
DIBROMOMETHANE	<0.001	<0.001
DICHLORODIFLUOROMETHANE	<0.001	<0.001
ETHYL METHACRYLATE	<0.01	<0.01
ETHYLBENZENE	<0.001	<0.001
IODOETHANE	<0.01	<0.01
XYLENE	<0.001	<0.001
METHYLENE CHLORIDE	<0.001	<0.001
STYRENE	<0.001	<0.001
TETRACHLOROETHENE	<0.0005	0.001
TOLUENE	0.001	0.0023
TRANS-1,2-DICHLOROETHENE	<0.001	<0.001
TRANS-1,3-DICHLOROPROPENE	<0.001	<0.001
TRICHLOROETHENE	<0.0005	<0.0005*
TRICHLOROFLUOROMETHANE	<0.001	<0.001
VINYL ACETATE	<0.01	<0.01
VINYL CHLORIDE	<0.0005	<0.0005

* DIS - Dissolved
* TOT - Total

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

APPENDIX A - SUMMARY OF WATER QUALITY ANALYSES
CHLD01 - City of Helena - Helena Landfill Mtn

Sample Type: Quality Control

SITE CODE	D.I. BLANK	RINSBLANK
SAMPLE DATE	01/22/92	05/19/92
SAMPLE TIME	08:30	14:00
LAB	EL	EL
LAB NUMBER	92-4685	92-19271
SAMPLE NUMBER	HL-9201-102	HL-9205-107

-- SEMI-VOLATILE EXTRACTABLES --
1,2,3-TRICHLOROPROPANE
1,4-DIFLUOROBENZENE

<0.001	<0.001
<0.01	<0.01

-- OTHER PARAMETERS --
CYANIDE (CN) *TOT
CHEMICAL OXYGEN DEMAND

<0.005	<0.005
<1.0	10.0

* DIS - Dissolved
* TOT - Total

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

Sample Type: Surface Water

SITE CODE POND
SAMPLE DATE 05/06/90
SAMPLE TIME 11:35
LAB EL
LAB NUMBER 90-10828
REMARKS Golf Course P
SAMPLE NUMBER HL-9005-111

— VOLATILE ORGANICS —

1,1,1,2-TETRACHLOROETHANE	<0.001
1,1,1-TRICHLOROETHANE	<0.0005
1,1,2,2-TETRACHLOROETHANE	<0.001
1,1,2-TRICHLOROETHANE	<0.001
1,1-DICHLOROETHANE	<0.001
1,1-DICHLOROETHENE	<0.0005
1,1-DICHLOROPROPENE	<0.001
1,2-DIBROMOETHANE	<0.001
1,2-DICHLOROETHANE	<0.0005
1,2-DICHLOROPROPANE	<0.001
2,2-DICHLOROPROPANE	<0.001
2-CHLOROTOLUENE	<0.001
4-CHLOROTOLUENE	<0.001
BENZENE	<0.0005
BROMOBENZENE	<0.001
BROMOCHLOROMETHANE	<0.001
BROMODICHLOROMETHANE	<0.001
BROMOFORM	<0.001
BROMOMETHANE	<0.001
CARBON TETRACHLORIDE	<0.0005
CHLOROBENZENE	<0.001
CHLOROETHANE	<0.001
CHLOROFORM	<0.001
CHLOROMETHANE	<0.001
CIS-1,2-DICHLOROETHENE	<0.001
CIS-1,3-DICHLOROPROPENE	<0.001
DIBROMOCHLOROMETHANE	<0.001
DIBROMOMETHANE	<0.001
DICHLOROETHYLENE	<0.001
ETHYLBENZENE	<0.001
M-XYLENE	<0.001
O-XYLENE	<0.001
P-XYLENE	<0.001
METHYLENE CHLORIDE	<0.001

* DIS - Dissolved
* TOT - Total

ALL quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. ALL results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

Sample Type: Surface Water

SITE CODE POND
SAMPLE DATE 05/06/90
SAMPLE TIME 11:35
LAB EL
LAB NUMBER 90-10828
REMARKS Golf Course P
SAMPLE NUMBER HL-9005-111

-- VOLATILE ORGANICS --

STYRENE <0.001
TETRACHLOROETHENE <0.0005
TOLUENE <0.001
TRANS-1,2-DICHLOROETHENE <0.001
TRANS-1,3-DICHLOROPROPENE <0.001
TRICHLOROETHENE <0.0005
TRICHLOROFLUOROMETHANE <0.001
VINYL CHLORIDE <0.0005

-- SEMI-VOLATILE EXTRACTABLES --

1,2,3-TRICHLOROBENZENE <0.001
1,2,3-TRICHLOROPROPANE <0.001
1,2,4-TRICHLOROBENZENE <0.001
1,2,4-TRIMETHYLBENZENE <0.001
1,2-DIBROMO-3-CHLOROPROPANE <0.001
1,2-DICHLOROBENZENE <0.001
1,3,5-TRIMETHYLBENZENE <0.001
1,3-DICHLOROBENZENE <0.001
1,3-DICHLOROPROPANE <0.001
1,4-DICHLOROBENZENE <0.0005
DICHLOROMONOFUOROMETHANE <0.001
HEXACHLOROBUTADIENE <0.001
ISOPROPYLBENZENE <0.001
N-BUTYLBENZENE <0.001
N-PROPYLBENZENE <0.001
NAPHTHALENE <0.001
P-ISOPROPYLTOLUENE <0.001
SEC-BUTYLBENZENE <0.001
TERT-BUTYLBENZENE <0.001

* DIS - Dissolved
* TOT - Total

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank Line indicates parameter not tested.

Sample Type: Other Sites

SITE CODE	BLANK	BLANK
SAMPLE DATE	11/11/89	05/07/90
SAMPLE TIME	19:00	09:15
LAB	EL	EL
LAB NUMBER	89-20184	90-10832
SAMPLE NUMBER	HL-8911-005	HL-9005-115

-- VOLATILE ORGANICS --

1,1,1,2-TETRACHLOROETHANE	<0.001	<0.001
1,1,1-TRICHLOROETHANE	<0.0005	<0.0005
1,1,2,2-TETRACHLOROETHANE	<0.001	<0.001
1,1,2-TRICHLOROETHANE	<0.001	<0.001
1,1-DICHLOROETHANE	<0.001	<0.001
1,1-DICHLOROETHENE	<0.0005	<0.0005
1,1-DICHLOROPROPENE	<0.001	<0.001
1,2-DIBROMOETHANE	<0.001	<0.001
1,2-DICHLOROETHANE	<0.0005	<0.0005
1,2-DICHLOROPROPANE	<0.001	<0.001
2,2-DICHLOROPROPANE	<0.001	<0.001
2-CHLOROTOLUENE	<0.001	<0.001
4-CHLOROTOLUENE	<0.001	<0.001
BENZENE	0.00073	<0.0005
BROMOBENZENE	<0.001	<0.001
BROMOCHLOROMETHANE	<0.001	<0.001
BROMODICHLOROMETHANE	<0.001	<0.001
BROMOFORM	<0.001	<0.001
BROMOMETHANE	<0.001	<0.001
CARBON TETRACHLORIDE	<0.0005	<0.0005
CHLOROBENZENE	<0.001	<0.001
CHLOROETHANE	<0.001	<0.001
CHLOROFORM	<0.001	<0.001
CHLOROMETHANE	<0.001	<0.001
CIS-1,2-DICHLOROETHENE	<0.001	<0.001
CIS-1,3-DICHLOROPROPENE	<0.001	<0.001
DIBROMOCHLOROMETHANE	<0.001	<0.001
DIBROMOMETHANE	<0.001	<0.001
DICHLORODIFLUOROMETHANE	<0.001	<0.001
ETHYLBENZENE	<0.001	<0.001
M-XYLENE	<0.001	<0.001
O-XYLENE	<0.001	<0.001
P-XYLENE	<0.001	<0.001
METHYLENE CHLORIDE	<0.001	<0.001
STYRENE	<0.001	<0.001

* DIS - Dissolved
* TOT - Total

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

Sample Type: Other Sites

SITE CODE	BLANK	BLANK
SAMPLE DATE	11/11/89	05/07/90
SAMPLE TIME	19:00	09:15
LAB	EL	EL
LAB NUMBER	89-20184	90-10832
SAMPLE NUMBER	HL-8911-005	HL-9005-115

-- VOLATILE ORGANICS --

TETRACHLOROETHENE	<0.0005	<0.0005
TOLUENE	0.001	<0.001
TRANS-1,2-DICHLOROETHENE	<0.001	<0.001
TRANS-1,3-DICHLOROPROPENE	<0.001	<0.001
TRICHLOROETHENE	<0.0005	<0.0005
TRICHLOROFLUOROMETHANE	<0.001	<0.001
VINYL CHLORIDE	<0.0005	<0.0005

-- SEMI-VOLATILE EXTRACTABLES --

1,2,3-TRICHLOROBENZENE	<0.001	<0.001
1,2,3-TRICHLOROPROPANE	<0.001	<0.001
1,2,4-TRICHLOROBENZENE	<0.001	<0.001
1,2,4-TRIMETHYLBENZENE	<0.001	<0.001
1,2-DIBROMO-3-CHLOROPROPANE	<0.001	<0.001
1,2-DICHLOROBENZENE	<0.001	<0.001
1,3,5-TRIMETHYLBENZENE	<0.001	<0.001
1,3-DICHLOROBENZENE	<0.001	<0.001
1,3-DICHLOROPROPANE	<0.001	<0.001
1,4-DICHLOROBENZENE	<0.0005	<0.0005
DICHLOROMONOFUOROMETHANE	<0.001	<0.001
HEXACHLOROBUTADIENE	<0.001	<0.001
ISOPROPYLBENZENE	<0.001	<0.001
N-BUTYLBENZENE	<0.001	<0.001
N-PROPYLBENZENE	<0.001	<0.001
NAPHTHALENE	<0.001	<0.001
P-ISOPROPYLTOLUENE	<0.001	<0.001
SEC-BUTYLBENZENE	<0.001	<0.001
TERT-BUTYLBENZENE	<0.001	<0.001

* DIS - Dissolved

* TOT - Total

ALL quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

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Page	Site Code	Site Name	Site Type	Elevation MP	Well Depth
25	13	13	Private Well		
25	19	19	Private Well		
25	20	20	Private Well		
25	23	23	Private Well		
28	26	26	Private Well		
28	28	28	Private Well		
28	31	31	Private Well		
28	32	32	Private Well		
28	34	34	Private Well		
31	36	36	Private Well		
31	38	38	Private Well		
31	40	40	Private Well		
31	42	42	Private Well		
34	47	47	Private Well		
34	48	48	Private Well		
34	5	5	Private Well		
34	51	51	Private Well		
34	52	52	Private Well		
37	59	59	Private Well		
37	67	67	Private Well		
37	68	68	Private Well		
37	75	75	Private Well		
3	82-2	82-2	Monitoring Wells		
3	82-3	82-3	Monitoring Wells		
3	82-4	82-4	Monitoring Wells		
3	83-5	83-5	Monitoring Wells		
3	83-6	83-6	Monitoring Wells		
8	83-7	83-7	Monitoring Wells		
40	84	84	Private Well		
40	9	9	Private Well		
47	BLANK	BLANK	Other Sites		
42	D.I. BLANK	D.I. BLANK	Quality Control		
8	EPA-1	EPA-1	Monitoring Wells		
8	FAIR GRND	FAIRGROUND-CITY WATER	Monitoring Wells		
8	HL-1	HL-1	Monitoring Wells		
12	HL-2	HL-2	Monitoring Wells		
12	HL-3	HL-3	Monitoring Wells		
12	HL-5	HL-5	Monitoring Wells		
12	HL-6	HL-6	Monitoring Wells		
12	HL-7	HL-7	Monitoring Wells		
12	HL-90-1	HL-90-1	Monitoring Wells		
				3990.86	
				3986.00	
					3942.48

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Page	Site Code	Site Name	Site Type	Elevation MP	Well Depth
15	HL-90-2	HL-90-2	Monitoring Wells	3950.96	
21	HL-90-3	HL-90-3	Monitoring Wells	3958.29	
1	I-3	I-3 GOLF COURSE	Irrigation Well		
45	POND	GOLF COURSE POND	Surface Water		
42	RINSEBLANK	RINSEBLANK	Quality Control		

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37	HL-0690-202	90-14927	06/01/90	59			
37	HL-0690-203	90-14928	06/01/90	67			
37	HL-0690-204	90-14929	06/01/90	67			
3	HL-8911-001	89-20180	11/11/89	82-4			
3	HL-8911-002	89-20181	11/11/89	82-2			
12	HL-8911-003	89-20182	11/11/89	HL-7			
8	HL-8911-004	89-20183	11/11/89	83-7			
47	HL-8911-005	89-20184	11/11/89	BLANK			
8	HL-8911-006	89-20185	11/13/89	HL-1			
3	HL-8911-900		11/13/89	83-6			
3	HL-8911-901		11/13/89	83-5			
12	HL-8911-902		11/13/89	HL-2			
12	HL-8911-903		11/13/89	HL-3			
3	HL-8911-904		11/13/89	82-3			
12	HL-8911-905		11/13/89	HL-5			
25	HL-90-10	90-3298	02/16/90	13			
21	HL-90-2-100	90-2765	02/02/90	HL-90-3			
28	HL-9005-100	90-10817	05/03/90	26			
28	HL-9005-101	90-10818	05/03/90	32			
31	HL-9005-102	90-10819	05/03/90	42			
28	HL-9005-103	90-10820	05/03/90	31			
31	HL-9005-104	90-10821	05/03/90	38			
25	HL-9005-105	90-10822	05/03/90	13			
25	HL-9005-106	90-10823	05/04/90	19			
28	HL-9005-107	90-10824	05/06/90	34			
25	HL-9005-108	90-10825	05/06/90	40			
25	HL-9005-109	90-10826	05/06/90	BLANK			
8	HL-9005-110	90-10827	05/06/90	38			
45	HL-9005-111	90-10828	05/06/90	I-3			
12	HL-9005-112	90-10829	05/06/90	HL-90-2			
12	HL-9005-113	90-10830	05/06/90	HL-90-1			
31	HL-9005-114	90-10831	05/06/90	82-4			
47	HL-9005-115	90-10832	05/06/90	48			
31	HL-9005-116	90-10833	05/06/90	51			
15	HL-9005-117	90-10834	05/06/90	59			
15	HL-9005-118	90-10835	05/06/90	67			
3	HL-9005-119	90-10836	05/06/90	67			
31	HL-9005-120	90-10837	05/06/90	28			
31	HL-9005-121	90-10838	05/06/90	FAIR GRND			
12	HL-9005-122	90-10839	05/06/90				
47	HL-9005-123	90-10840	05/06/90				
1	HL-9005-124	90-10841	05/06/90				
15	HL-9005-125	90-10842	05/06/90				
15	HL-9005-126	90-10843	05/06/90				
3	HL-9005-127	90-10844	05/06/90				
31	HL-9005-128	90-10845	05/06/90				
31	HL-9005-129	90-10846	05/06/90				
45	HL-9005-130	90-10847	05/06/90				
12	HL-9005-131	90-10848	05/06/90				
12	HL-9005-132	90-10849	05/06/90				
31	HL-9005-133	90-10850	05/06/90				
47	HL-9005-134	90-10851	05/06/90				
1	HL-9005-135	90-10852	05/06/90				
15	HL-9005-136	90-10853	05/06/90				
15	HL-9005-137	90-10854	05/06/90				
3	HL-9005-138	90-10855	05/06/90				
31	HL-9005-139	90-10856	05/06/90				
31	HL-9005-140	90-10857	05/06/90				
45	HL-9005-141	90-10858	05/06/90				
12	HL-9005-142	90-10859	05/06/90				
12	HL-9005-143	90-10860	05/06/90				
31	HL-9005-144	90-10861	05/06/90				
47	HL-9005-145	90-10862	05/06/90				
1	HL-9005-146	90-10863	05/06/90				
15	HL-9005-147	90-10864	05/06/90				
15	HL-9005-148	90-10865	05/06/90				
3	HL-9005-149	90-10866	05/06/90				
31	HL-9005-150	90-10867	05/06/90				
31	HL-9005-151	90-10868	05/06/90				
45	HL-9005-152	90-10869	05/06/90				
12	HL-9005-153	90-10870	05/06/90				
12	HL-9005-154	90-10871	05/06/90				
31	HL-9005-155	90-10872	05/06/90				
47	HL-9005-156	90-10873	05/06/90				
1	HL-9005-157	90-10874	05/06/90				
15	HL-9005-158	90-10875	05/06/90				
15	HL-9005-159	90-10876	05/06/90				
3	HL-9005-160	90-10877	05/06/90				
31	HL-9005-161	90-10878	05/06/90				
31	HL-9005-162	90-10879	05/06/90				
45	HL-9005-163	90-10880	05/06/90				
12	HL-9005-164	90-10881	05/06/90				
12	HL-9005-165	90-10882	05/06/90				
31	HL-9005-166	90-10883	05/06/90				
47	HL-9005-167	90-10884	05/06/90				
1	HL-9005-168	90-10885	05/06/90				
15	HL-9005-169	90-10886	05/06/90				
15	HL-9005-170	90-10887	05/06/90				
3	HL-9005-171	90-10888	05/06/90				
31	HL-9005-172	90-10889	05/06/90				
31	HL-9005-173	90-10890	05/06/90				
45	HL-9005-174	90-10891	05/06/90				
12	HL-9005-175	90-10892	05/06/90				
12	HL-9005-176	90-10893	05/06/90				
31	HL-9005-177	90-10894	05/06/90				
47	HL-9005-178	90-10895	05/06/90				
1	HL-9005-179	90-10896	05/06/90				
15	HL-9005-180	90-10897	05/06/90				
15	HL-9005-181	90-10898	05/06/90				
3	HL-9005-182	90-10899	05/06/90				
31	HL-9005-183	90-10900	05/06/90				
31	HL-9005-184	90-10901	05/06/90				
45	HL-9005-185	90-10902	05/06/90				
12	HL-9005-186	90-10903	05/06/90				
12	HL-9005-187	90-10904	05/06/90				
31	HL-9005-188	90-10905	05/06/90				
47	HL-9005-189	90-10906	05/06/90				
1	HL-9005-190	90-10907	05/06/90				
15	HL-9005-191	90-10908	05/06/90				
15	HL-9005-192	90-10909	05/06/90				
3	HL-9005-193	90-10910	05/06/90				
31	HL-9005-194	90-10911	05/06/90				
31	HL-9005-195	90-10912	05/06/90				
45	HL-9005-196	90-10913	05/06/90				
12	HL-9005-197	90-10914	05/06/90				
12	HL-9005-198	90-10915	05/06/90				
31	HL-9005-199	90-10916	05/06/90				
47	HL-9005-200	90-10917	05/06/90				
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15	HL-9005-202	90-10919	05/06/90				
15	HL-9005-203	90-10920	05/06/90				
3	HL-9005-204	90-10921	05/06/90				
31	HL-9005-205	90-10922	05/06/90				
31	HL-9005-206	90-10923	05/06/90				
45	HL-9005-207	90-10924	05/06/90				
12	HL-9005-208	90-10925	05/06/90				
12	HL-9005-209	90-10926	05/06/90				
31	HL-9005-210	90-10927	05/06/90				
47	HL-9005-211	90-10928	05/06/90				
1	HL-9005-212	90-10929	05/06/90				
15	HL-9005-213	90-10930	05/06/90				
15	HL-9005-214	90-10931	05/06/90				
3	HL-9005-215	90-10932	05/06/90				
31	HL-9005-216	90-10933	05/06/90				
31	HL-9005-217	90-10934	05/06/90				
45	HL-9005-218	90-10935	05/06/90				
12	HL-9005-219	90-10936	05/06/90				
12	HL-9005-220	90-10937	05/06/90				
31	HL-9005-221	90-10938	05/06/90				
47	HL-9005-222	90-10939	05/06/90				
1	HL-9005-223	90-10940	05/06/90				
15	HL-9005-224	90-10941	05/06/90				
15	HL-9005-225	90-10942	05/06/90				
3	HL-9005-226	90-10943	05/06/90				
31	HL-9005-227	90-10944	05/06/90				
31	HL-9005-228	90-10945	05/06/90				
45	HL-9005-229	90-10946	05/06/90				
12	HL-9005-230	90-10947	05/06/90				
12	HL-9005-231	90-10948	05/06/90				
31	HL-9005-232	90-10949	05/06/90				
47	HL-9005-233	90-10950	05/06/90				
1	HL-9005-234	90-10951	05/06/90				
15	HL-9005-235	90-10952	05/06/90				
15	HL-9005-236	90-10953	05/06/90				
3	HL-9005-237	90-10954	05/06/90				
31	HL-9005-238	90-10955	05/06/90				
31	HL-9005-239	90-10956	05/06/90				
45	HL-9005-240	90-10957	05/06/90				
12	HL-9005-241	90-10958	05/06/90				
12	HL-9005-242	90-10959	05/06/90				
31	HL-9005-243	90-10960	05/06/90				
47	HL-9005-244	90-10961	05/06/90				
1	HL-9005-245	90-10962	05/06/90				
15	HL-9005-246	90-10963	05/06/90				
15	HL-9005-247	90-10964	05/06/90				
3	HL-9005-248	90-10965	05/06/90				
31	HL-9005-249	90-10966	05/06/90				
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45	HL-9005-251	90-10968	05/06/90				
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8	HL-9006-101	90-15039	06/05/90	FAIR GRND	40	90-15042	HL-9006-104	06/06/90	9
31	HL-9006-102	90-15040	06/05/90	36	40	90-15044	HL-9006-106	06/06/90	84
40	HL-9006-104	90-15042	06/06/90	9	21	90-2765	HL-90-2-100	02/02/90	HL-90-3
40	HL-9006-106	90-15044	06/06/90	84	12	90-2766	HL-90-2-101	02/02/90	HL-90-1
25	HL-9104-100	91-12763	04/04/91	13	15	90-2767	HL-90-2-102	02/03/90	HL-90-2
37	HL-9104-101	91-12764	04/04/91	68	25	90-3298	HL-90-10	02/16/90	13
34	HL-9104-102	91-12765	04/04/91	52	25	91-12763	HL-9104-100	04/04/91	13
37	HL-9104-103	91-12766	04/04/91	59	37	91-12764	HL-9104-101	04/04/91	68
15	HL-9104-104	91-12767	04/04/91	HL-90-2	34	91-12765	HL-9104-102	04/04/91	52
8	HL-9104-105	91-12768	04/05/91	EPA-1	37	91-12766	HL-9104-103	04/04/91	59
3	HL-9104-106	91-12769	04/05/91	83-6	15	91-12767	HL-9104-104	04/04/91	HL-90-2
21	HL-9104-107	91-12770	04/05/91	HL-90-3	8	91-12768	HL-9104-105	04/05/91	EPA-1
15	HL-9104-108	91-12771	04/05/91	HL-90-1	3	91-12769	HL-9104-106	04/05/91	83-6
31	HL-9104-109	91-13086	04/13/91	40	21	91-12770	HL-9104-107	04/05/91	HL-90-3
34	HL-9104-110	91-13087	04/13/91	5	15	91-12771	HL-9104-108	04/05/91	HL-90-1
28	HL-9104-111	91-13088	04/13/91	31	15	91-12772	HL-9104-118	04/05/91	HL-90-1
15	HL-9104-118	91-12772	04/05/91	HL-90-1	31	91-13086	HL-9104-109	04/13/91	40
21	HL-9201-100	92-4683	01/21/92	HL-90-3	34	91-13087	HL-9104-110	04/13/91	5
15	HL-9201-101	92-4684	01/21/92	HL-90-1	28	91-13088	HL-9104-111	04/13/91	31
42	HL-9201-102	92-4685	01/22/92	D.I. BLANK	21	92-19269	HL-9205-109	05/19/92	HL-90-3
8	HL-9201-103	92-4687	01/22/92	EPA-1	15	92-19270	HL-9205-122	05/19/92	HL-90-1
15	HL-9201-104	92-4686	01/22/92	HL-90-2	42	92-19271	HL-9205-107	05/19/92	RINSBLANK
37	HL-9201-105	92-4688	01/22/92	59	15	92-19272	HL-9205-101	05/19/92	HL-90-2
34	HL-9201-106	92-4689	01/22/92	47	15	92-19273	HL-9205-119	05/19/92	HL-90-2
37	HL-9201-107	92-4690	01/22/92	75	8	92-19274	HL-9205-103	05/19/92	83-6
31	HL-9201-108	92-4691	01/22/92	38	8	92-19275	HL-9205-123	05/20/92	EPA-1
25	HL-9201-109	92-4692	01/22/92	13	25	92-19276	HL-9205-105	05/20/92	13
28	HL-9201-110	92-5002	01/29/92	31	37	92-19277	HL-9205-102	05/20/92	59
3	HL-9201-111	92-5001	01/31/92	83-6	37	92-19278	HL-9205-100	05/20/92	75
37	HL-9205-100	92-19278	05/20/92	75	34	92-19279	HL-9205-110	05/20/92	48
15	HL-9205-101	92-19272	05/19/92	HL-90-2	31	92-19287	HL-9205-118	05/28/92	40
37	HL-9205-102	92-19277	05/20/92	59	28	92-19288	HL-9205-112	05/28/92	31
8	HL-9205-103	92-19274	05/19/92	83-6	34	92-19289	HL-9205-114	05/28/92	52
25	HL-9205-105	92-19276	05/20/92	13	21	92-4683	HL-9201-100	01/21/92	HL-90-3
42	HL-9205-107	92-19271	05/19/92	RINSBLANK	15	92-4684	HL-9201-101	01/21/92	HL-90-1
21	HL-9205-109	92-19269	05/19/92	HL-90-3	42	92-4685	HL-9201-102	01/22/92	D.I. BLANK
34	HL-9205-110	92-19279	05/20/92	48	15	92-4686	HL-9201-104	01/22/92	HL-90-2
28	HL-9205-112	92-19288	05/28/92	31	8	92-4687	HL-9201-103	01/22/92	EPA-1
34	HL-9205-114	92-19289	05/28/92	52	37	92-4688	HL-9201-105	01/22/92	59

APPENDIX A - SUMMARY OF WATER QUALITY ANALYSES
 QHLO1 - City of Helena - Helena Landfill Mtnng

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15	HL-9205-122	92-19270	05/19/92	HL-90-1	31	92-4691	HL-9201-108	01/22/92	38
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12	HL90-2-101	90-2766	02/02/90	HL-90-1	3	92-5001	HL-9201-111	01/31/92	83-6
15	HL90-2-102	90-2767	02/03/90	HL-90-2	28	92-5002	HL-9201-110	01/29/92	31

APPENDIX B

STORM DRAIN OUTFALL FLOW MEASUREMENTS

FLOW DISCHARGE CALCULATION

Project: City of Helena Landfill
Station: Riser-2
Date Measured: 03-15-91

STATION	DIST. (ft)	WIDTH (ft)	DEPTH (ft)	VEL. (ft/sec)	AREA (ft ²)	DISCHARGE (cfs)
I.O.W.	0.30	0.15	0	0	0.04	0
1	0.50	0.25	0.15	0.25	0.04	0.01
2	0.80	0.20	0.20	0.35	0.04	0.01
3	1.00	0.20	0.25	0.30	0.04	0.01
4	1.20	0.20	0.35	0.30	0.06	0.02
5	1.40	0.25	0.30	0.38	0.06	0.02
6	1.60	0.20	0.35	0.43	0.06	0.02
7	1.80	0.20	0.30	0.52	0.04	0.01
8	2.00	0.20	0.35	0.72	0.03	0.00
9	2.30	0.15	0.05	0	0.00	0.00
E.O.W.	2.30	0.05	0	0	0.00	0

APPENDIX B.

Flow = 0.12

STORM DRAIN OUTFALL FLOW MEASUREMENTS

Flow Method: Pygmy Current Meter
Calc. Method: Rectangular Area Method
Gage Height: ft. Water Temp. (C): Air Temp. (C):
Weather: Partly Cloudy Measured by: MGP
Measurement Conditions: FFS (0.05)
Calculated Flow: 0.12 ± 0.007 cfs
Process program and date: SD-92 (05-17-1991)

25' downstream from tunnel

FLOW DISCHARGE CALCULATION

Project: City of Helena Landfill
Station: hlsr-2
Date Measured: 05-16-91

STATION	DIST. (ft)	WIDTH (ft)	DEPTH (ft)	VEL. (ft/sec)	AREA (ft^2)	DISCHARGE (cfs)
E.O.W.	0.30	0.15	0	0		0
1	0.60	0.25	0.15	0.28	0.04	0.01
2	0.80	0.20	0.20	0.25	0.04	0.00
3	1.00	0.20	0.20	0.30	0.04	0.01
4	1.20	0.20	0.30	0.30	0.06	0.02
5	1.40	0.20	0.30	0.38	0.06	0.02
6	1.60	0.20	0.25	0.43	0.05	0.02
7	1.80	0.20	0.20	0.32	0.04	0.01
8	2.00	0.20	0.15	0.22	0.03	0.00
9	2.20	0.15	0.05	0.17	0.00	0.00
E.O.W.	2.30	0.05	0	0		0
Flow =						0.12

Flow Method: Pygmy Current Meter
Calc. Method: Rectangular Area Method
Gage Height: ft. Water Temp. (C): Air Temp. (C):
Weather: Partly Cloudy Measured by: WGP
Measurement Conditions: FAIR (8 %)
Calculated Flow: 0.12 + 0.00cfs
Process program and date: HCM-05 (05-17-1991)

25' downstream from tunnel

HYDROMETRICS

HELENA, MT

FLOW DISCHARGE CALCULATION

Project: City of Helena Landfill

Station: HLSR-1

Date Measured: 05-16-91

STATION	DIST. (ft)	WIDTH (ft)	DEPTH (ft)	VEL. (ft/sec)	AREA (ft^2)	DISCHARGE (cfs)
E.O.W.	2.00	0.15	0	0		0
1	2.30	0.30	0.15	0.00	0.04	0.00
2	2.60	0.30	0.30	0.30	0.09	0.03
3	2.90	0.30	0.40	0.28	0.12	0.03
4	3.20	0.30	0.55	0.17	0.16	0.03
5	3.50	0.30	0.60	0.22	0.18	0.04
6	3.80	0.30	0.60	0.17	0.18	0.03
7	4.10	0.30	0.60	0.08	0.18	0.01
8	4.40	0.30	0.55	0.05	0.16	0.00
9	4.70	0.30	0.45	0.00	0.13	0.00
10	5.00	0.30	0.30	0.00	0.09	0.00
E.O.W.	5.30	0.15	0	0		0

Flow = 0.18

Flow Method: Pygmy Current Meter

Calc. Method: Rectangular Area Method

Gage Height: ft. Water Temp. (C): Air Temp. (C):

Weather: Partly Cloudy Measured by: wgp

Measurement Conditions: FAIR (8 %)

Calculated Flow: 0.18 + 0.01cfs

Process program and date: HCM-05 (05-17-1991)

65' Inside tunnel

143' OUTSIDE TUNNEL

Notes, by

STREAM GAGING - PICHY, METER (0.8 DEPTH)

PROJECT: Capt-Landfill DATE: 5
SITE: HLR-3 FLOW: _____

[illegible]

PARTY _____ COMP. BY _____ CKED. BY _____
 WEATHER _____ AIR TEMP. _____ WATER TEMP. _____
 STREAM & BOTTOM COND. _____
 MEAS. COND. & RATING GOOD (5%), FAIR (10%), POOR (12%), VERY POOR (20%).
 OTHER (EXPLAIN) _____
 GAGE HEIGHT _____ REMARKS _____

143' OUTSIDE TURNS.



Figure 1

STREAM GAGING - RIGBY, METER (0.6 DEPTH)

PROJECT: COM - Exchange DATE: 5-16-91
SITE: HSK-4 FLOW: _____

[illegible]

PARTY _____ COMP. BY _____ CKED. BY _____
 WEATHER _____ AIR TEMP. _____ WATER TEMP. _____
 STREAM & BOTTOM COND. _____
 WEAS. COND. & RATING GOOD (5%), FAIR (8%), POOR (12%), VERY POOR (20%).
 OTHER (EXPLAIN) _____
 GAGE HEIGHT _____ REMARKS _____

300' outside Tunnel

COVER SOIL TESTING DATA

u:\sdowns...chhl01\revclose.skd

Letter of Transmittal

BRAUNSM
INTERTEC

Braun Intertec Corporation

To: Steve Downs
Hydrometrics, Inc.
2727 Airport Road
Helena, MT 59601

Date: 1/12/93Job No: BHDX-92-212L

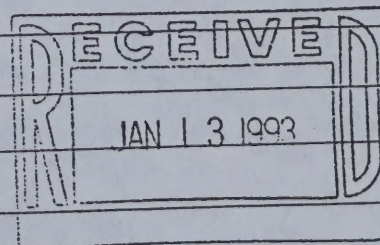
Re: Permeability Test & Proctor
P.O. # 5225

We are sending you the following items: ☒ attached
☐ under separate cover via _____

1 Permeability Test
1 Proctor

These are being sent: ☐ for approval ☐ for review and comment ☒ for your use ☒ as requested

Remarks: _____



Copy to: _____

Signed: Nathan P. BorschardTitle: Materials ENGR.

Phone: _____

PERMEABILITY TEST – ASTM D 5084
METHOD A – CONSTANT HEAD/METHOD C – FALLING HEAD – RISING TAILWATER

Project: BHDX-92-212L Date: 1/4/93
(WATERBURY SOILS)
 Boring: _____ Sample #: HLWS-100 Depth: _____
 Description: SANDY LEAN CLAY with GRAVEL, low plasticity, fine to coarse grained gravel, gray.
Sample was remolded to approximately 90% of standard proctor.

Initial	Final
Wt Specimen + Tare Wet <u>143.56</u>	Wt Specimen + Tare Wet <u>740.20</u>
Wt Specimen + Tare Dry <u>128.65</u>	Wt Specimen + Tare Dry <u>624.80</u>
Wt Tare <u>34.95</u>	Wt Tare <u>115.40</u>
Moisture Content <u>15.9%</u>	Moisture Content <u>22.7%</u>

Diameter <u>2.87</u> in	A = (2.87=41.74 cm ²) or (1.94 = 19.07 cm ²)	<u>41.74</u> cm ²
Height L= <u>7.5</u> cm	Wt of specimen (gms) <u>600.70</u>	Dry Unit Wt. (pcf) <u>103.4</u>
Sp. Gravity <u>2.650</u>	Initial Saturation <u>70.3%</u>	Final Saturation <u>100.1%</u>

Burette Area a=1 cm² or 0.713 cm² 0.7263 Differential pressure 1 psi = 70.3 cm
 Confining Pressure (psi) 5.0 Overburden 720 psf

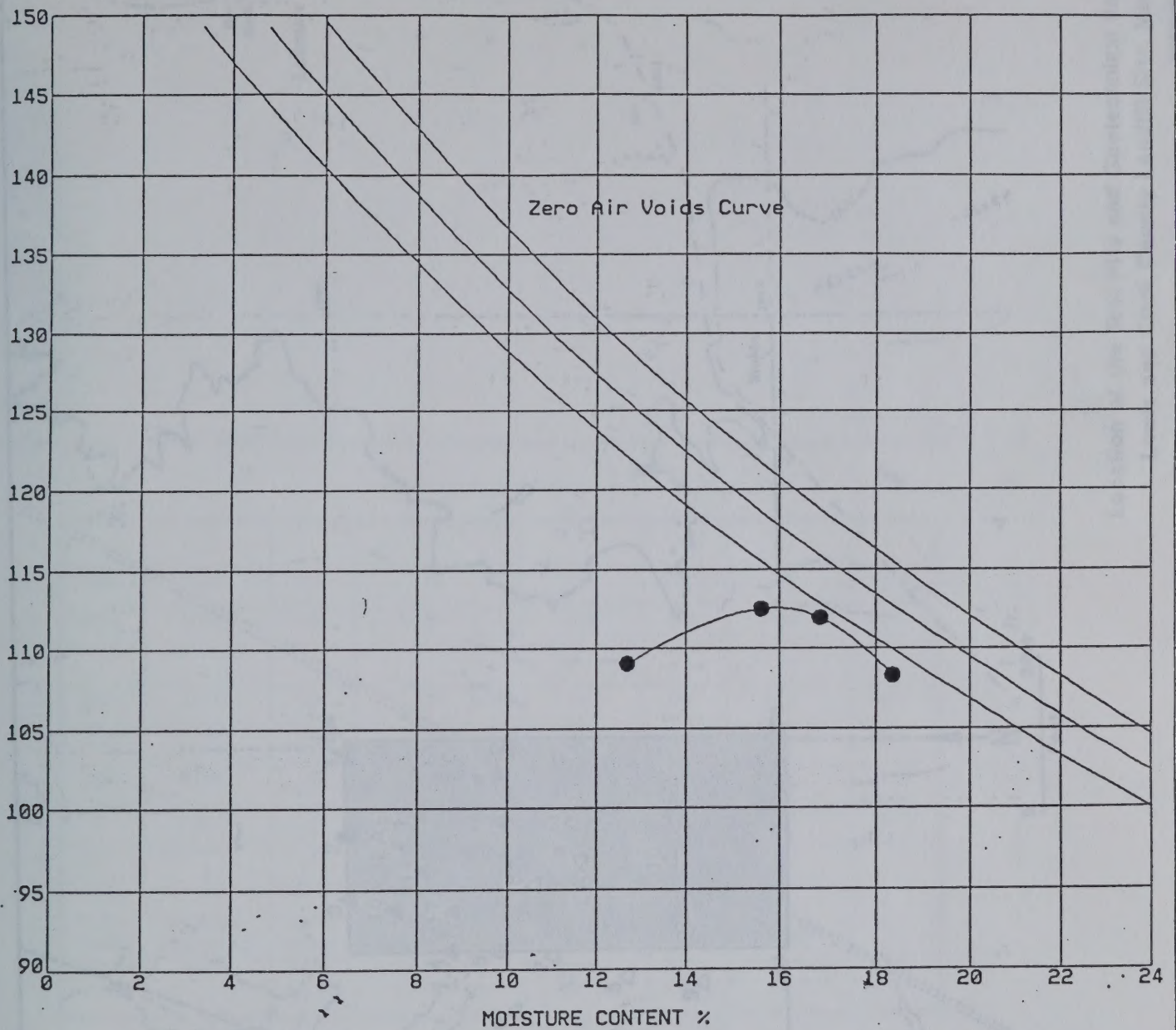
	Time (t) sec	H1 cm	H2 cm	hi cm	hf cm	havg cm	Q cc	Method A K cm/sec	Method C K cm/sec
Initial	0	23.2	32.6	60.9					
Final	39660	16.5	39.3		47.5	54.2	4.8662		
Result								4.1E-07	4.1E-07
Initial	0	49.6	6.1	113.8					
Final	49200	34	21.7		82.6	98.2	11.3303		
Result								4.2E-07	4.2E-07
Initial	0	25.6	30.1	65.8					
Final	109260	9.2	46.5		33.0	49.4	11.9113		
Result								4.0E-07	4.1E-07
Initial	0	22.6	33.3	59.6					
Final	67920	12	43.8		38.5	49.1	7.6625		
Result								4.1E-07	4.2E-07
Average Permeability								4.1E-07	4.2E-07
Assigned Permeability									

Remarks: B coefficient = 98%
A specific gravity of 2.65 was assumed for the purpose of saturation calculations.

Braun Intertec Engineering, Inc.

William P. Borshans
 Materials Engineer

Walmart Barrow Area



MAXIMUM DRY
DENSITY, pcf
112.5

OPTIMUM MOISTURE
CONTENT %
15.5

SAMPLE NO: HLWS-100 DEPTH: ---

Soil Description: GRAVELLY CLAY, medium plasticity, fine to coarse grained gravel brown.

ASTM D 698
METHOD: C

Job No:
BHOX-92-212L
Appr:

Date:
NOV 2, 1992

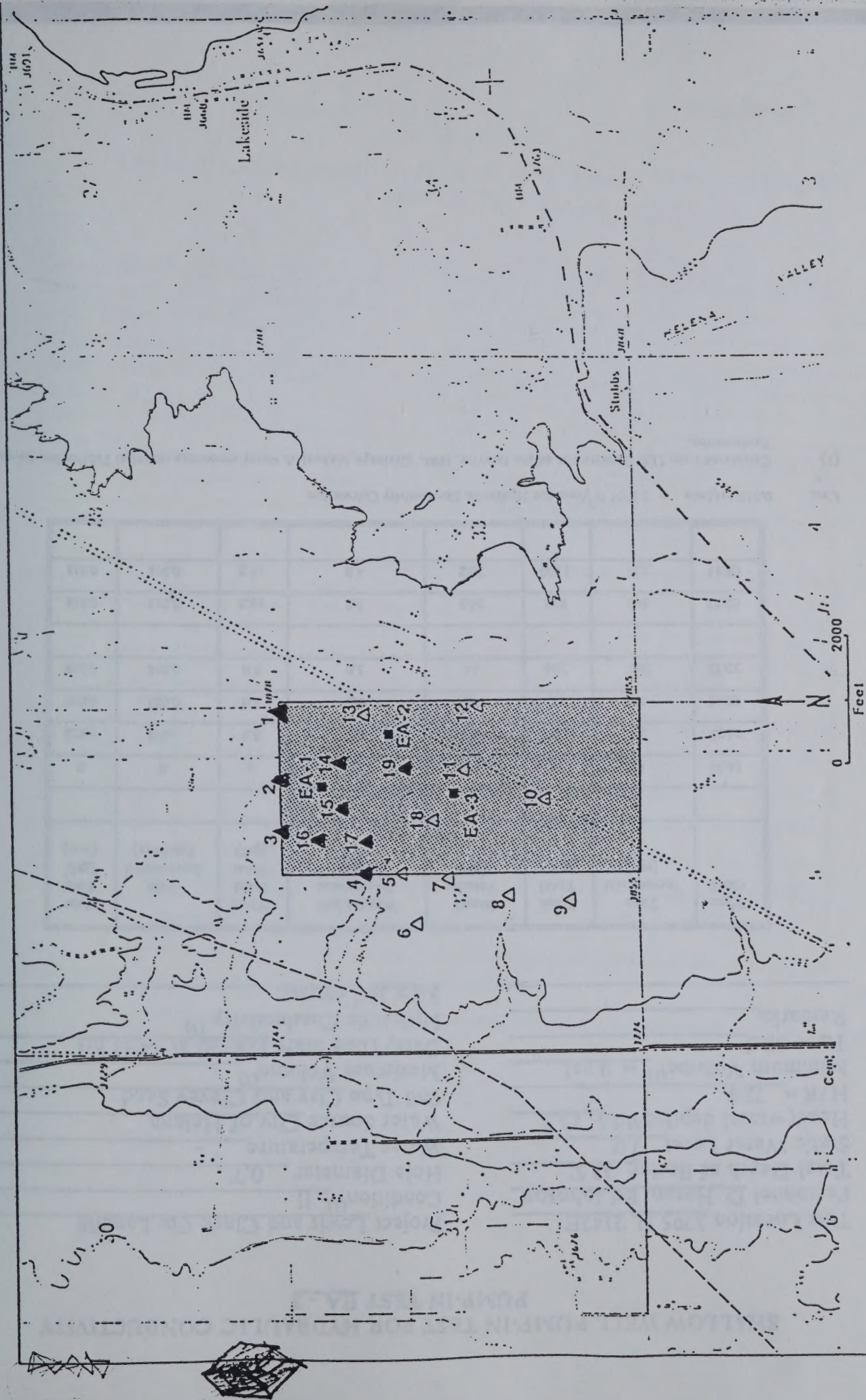
MOISTURE-DENSITY CURVE (PROCTOR)

Helena Landfill
Helena, Montana

Braun Intertec Engineering, Inc., Billings, Montana

PLATE

P-1



Location of the Test Pits and Geotechnical Borings
Lewis and Clark County Landfill Site, Montana
FIGURE 2-5

SHALLOW WELL PUMP-IN TEST FOR HYDRAULIC CONDUCTIVITY

PUMP-IN TEST EA - 3

Test Location 3795 N. 2142E
 Personnel D. Hazen, Ed Johnson
 Total Depth of Boring 32.5'
 Static Water Level 7.0'
 Head(=total depth-SWL) 25.5
 H/R = 72.9
 Minimum Volume⁽¹⁾ ≈ 9 gal
 Tu = 32.5
 Remarks _____

Project Lewis and Clark Co. Landfill
 Condition⁽¹⁾ II
 Hole Diameter 0.7'
 Water Temperature -
 Water Source City of Helena
 Soil Type Clay and Clayey Sand
 Maximum Volume⁽¹⁾ _____
 Date/Time Start 1/8/90 at 14:54 hrs
 Hydraulic Conductivity⁽¹⁾
 3.4×10^{-7} cm/sec

Time Clock	Time Incremental (min)	Time Total (min)	Barrel Volume (gal)	Water Used Incremental (gal)	Water Used Total (gal)	Rate Incremental (gal/min)	Rate Total (gal/ min)
14:54	0	0	50	0	0	0	0
15:27	33	33	49.5	0.5	0.5	0.015	0.015
15:45	18	51	49	0.5	1.0	0.028	0.020
20:30	285	336	44	5.0	6.0	0.018	0.018
05:30	540	876	34.5	9.5	15.5	0.018	0.018
09:14	224	1100	30.2	4.0	19.5	0.018	0.018

Use: 0.018 gal/min = 0.0024 ft³/min for Hydraulic Conductivity Calculation

(1) Calculated from U.S. Department of the Interior, 1984. Drainage Manual. A water resources technical Publication, Bureau of Reclamation.

SHALLOW WELL PUMP-IN TEST FOR HYDRAULIC CONDUCTIVITY PUMP-IN TEST EA - 2

Test Location 4659 N. 3164E
 Personnel D. Hazen, Ed Johnson
 Total Depth of Boring 34.0'
 Static Water Level 5.5'
 Head (= total depth-SWL) 28.5
 H/R = 81.4'
 Minimum Volume⁽¹⁾ ≈ 9 gal
 Tu = 34.0
 Remarks _____

Project Lewis and Clark Co. Landfill
 Condition⁽¹⁾ II
 Hole Diameter 0.7
 Water Temperature -
 Water Source City of Helena
 Soil Type Clay and Clayey Sand
 Maximum Volume⁽¹⁾ _____
 Date/Time Start 1/9/90 at 10:53 hrs
 Hydraulic Conductivity⁽¹⁾
 1.2×10^{-7} cm/sec

Time Clock	Time Incremental (min)	Time Total (min)	Barrel Volume (gal)	Water Used Incremental (gal)	Water used Total (gal)	Rate Incremental (gal/min)	Rate Total (gal/min)
10:53	0	0	51.0	0	0		
14:11	198	198	49.3	1.7	1.7	0.0086	0.0086
16:35	144	342	48.0	1.3	3.0	0.009	0.0088
20:07	212	554	46.75	1.25	4.25	0.006	0.0077
06:00	593	1147	42.25	4.5	8.75	0.0076	0.0076
08:52	172	1319	41.0	1.25	10.0	0.0073	0.0076

Use: $0.0076 \text{ gal/min} = 0.001 \text{ ft}^3/\text{min}$ for Hydraulic Conductivity calculation

(1) Calculated from U.S. Department of the Interior, 1934. Drainage Manual, A water resources technical Publication, Bureau of Reclamation.

SHALLOW WELL PUMP-IN TEST FOR HYDRAULIC CONDUCTIVITY

PUMP-IN TEST EA - 1

Test Location 5669 N. 2461E
 Personnel D. Hazen, Ed Johnson
 Total Depth of Boring 34.0'
 Static Water Level 4'
 Head (=total depth-SWL) 30'
 H/R = 85.7'
 Minimum Volume⁽¹⁾ ≈ 9 gal
 Tu = 34.0
 Remarks _____

Project Lewis and Clark Co. Landfill
 Condition⁽¹⁾ II
 Hole Diameter 8.3/8", 0.7'
 Water Temperature -
 Water Source City of Helena
 Soil Type Clay with fine sand, clayey sand
 Maximum Volume⁽¹⁾ _____
 Date/Time Start 12/7/89 at: 17hrs
 Hydraulic Conductivity⁽¹⁾
 6.8×10^{-7} cm/sec

Time Clock	Time Incremental (min)	Time Total (min)	Barrel Volume (gal)	Water Used Incremental (gal)	Water Used Total (gal)	Rate Incremental (gal/min)	Rate Total (gal/min)
15:17	0	0	48	0	0		
16:00	43	43	47.2	0.8	0.8	0.019	0.019
21:03	303	346	36.5	10.7	11.5	0.035	0.033
6:11	548	894	11.0	25.5	37.0	0.046	0.041

Use: $0.045 \text{ gal/min} = 0.006 \text{ ft}^3/\text{min}$ for Hydraulic Conductivity Calculation

- (1) Calculated from U.S. Department of the Interior, 1984. Drainage Manual, A water resources technique Publication, Bureau of Reclamation.

APPENDIX D.

TOPSOIL DATA



204 -- Weingart-Assiniboine complex, 2 to 8 percent slopes

Composition

Gravel and silt: 50 percent

Silt, sand and smaller soils: 45 percent

Clay: 5 percent

Setting

Location: mainly southern part

Topography: uplands

Soils: mixed

* Soils are too intricately mixed for position description

Notes:

* Weingart - 2 to 8 percent

* Assiniboine - 2 to 8 percent

Elevation: 3800 to 4500 feet

Mean Annual Precipitation: 10 to 14 inches

Frost-free period: 105 to 120 days

Typical Profile

Weingart soil

0 to 6 inches - light gray loam clay loam when mixed 0 to 7 inches
6 to 17 inches - white clay
17 to 30 inches - pale brown clay
30 to 60 inches - pale yellow to white semiconsolidated loamy
sedimentary beds

Assinniboine soil

0 to 8 inches - grayish brown sandy loam
8 to 9 inches - grayish brown sandy clay loam
9 to 14 inches - pale brown sandy clay loam
14 to 36 inches - white sandy loam
36 to 60 inches - light gray sandy loam

Soil Properties and Qualities

Weingart soil

Depth to water: moderately deep

Drainage class: well drained

Parent material: sources - shale and semiconsolidated sedimentary beds

Soil texture: moderately sodic

Salinity: moderately saline at 17 to 30 inches

Permeability: very slow

Available water capacity: mainly 5 inches

Runoff: medium

Associated with:

Gravelly loam - 0-2

Gravelly loam - 2-4

Gravelly loam - 4-6

Gravelly loam - 6-8

Gravelly loam - 8-10

Gravelly loam - 10-12

Inclusions

- * soils that have slopes of more than 5 percent
- * soils that have loam texture throughout the profile
- * soils that are moderately deep and clayey throughout the profile
- * moderately deep soils with a sandy loam surface, and a sand clay loam

Uses of the Unit

Common interest uses:

- * irrigated cropland
- * nonirrigated cropland

Cropland

Commonly grown crops:

- * nonirrigated - spring wheat, winter wheat, barley
- * irrigated - spring wheat, barley, alfalfa hay, grass-legume hay, pasture

Arlingford soilCapability classification:

* Iva, nonirrigated

* Iva, irrigated

Major soil limitations and hazards:

* erosion by water

* poor to no permeability

* highly to excessively leached sedimentary beds and shale

* poor drain

* salt content

* sodium content

* soil blowing

* surface crusting

* limited available water capacity

Assiniboine soilCapability classification:

* Iva, nonirrigated

* Iva, irrigated

Major soil limitations and hazards:

* soil blowing

* erosion by water

Rangeland

Wellingart soil

Wellingart soil is a light gray to light brown silty clay loam with 10 to 20 percent sand.

Assiniboine soil

Assiniboine soil is a light gray to light brown silty clay loam with 10 to 20 percent sand.

Windbreaks

Wellingart soil

Wellingart soil is a light gray to light brown silty clay loam with 10 to 20 percent sand.

Assiniboine soil

Assiniboine soil

Assiniboine soil is a light gray to light brown silty clay loam with 10 to 20 percent sand.

Assiniboine soil

Assiniboine soil

Assiniboine soil is a light gray to light brown silty clay loam with 10 to 20 percent sand.

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Assiniboine soil is a light gray to light brown silty clay loam with 10 to 20 percent sand.

Assiniboine soil is a light gray to light brown silty clay loam with 10 to 20 percent sand.

Typical Profile

Grays soil

Grays soil is a light gray to light brown silty clay loam with 10 to 20 percent sand.

Grays soil is a light gray to light brown silty clay loam with 10 to 20 percent sand.

Grays soil is a light gray to light brown silty clay loam with 10 to 20 percent sand.

34 -- Crago-Musselshell gravelly loams, 4 to 35 percent slopes

Composition

Crago and similar soils: 55 percent

Musselshell and similar soils: 40 percent

Inclusions: 10 percent

Setting

Located in survey area: mainly southern part

Landform: fan terraces, stream terrace edges, footslopes of uplands

Position on landform:

* soils are too intricately mixed for position description

Slope ranges:

* Crago soil - 4 to 35 percent

* Musselshell soil - 4 to 35 percent

Elevation: 3600 to 5000 feet

Mean annual precipitation: 10 to 14 inches

Frost-free period: 105 to 120 days

Typical Profile

Crago soil

0 to 4 inches - light brownish gray gravelly loam

4 to 32 inches - white very gravelly loam

32 to 60 inches - very pale brown extremely gravelly sandy loam

Musselshell soil

0 to 4 inches - grayish brown grave ly loam
4 to 12 inches - light gray silty to gravelly loam
12 to 24 inches - white very gravelly sandy loam
24 to 60 inches - very pale brown gravelly loam

Soil Properties and Qualities**Crago soil**

Depth class: very deep
Drainage class: well drained
Parent material: alluvium from limestone
Permeability: moderate
Available water capacity: mainly 4.6 inches
Runoff: rapid

Musselshell soil

Depth class: very deep
Drainage class: well drained
Parent material: alluvium from limestone
Permeability: moderate
Available water capacity: mainly 6 inches
Runoff: rapid

Inclusions

- * soils that have slopes of more than 25 percent
- * soils that have a depth of 10 to 20 inches of surface layer
- * soils that have depth of 10 to 20 inches
- * soils that are low or dry low throughout the profile

Uses of the Unit

Range Land Uses:

- * range land

Cropland

Commonly grown crops:

- * nonirrigated - none

Cropland

Capability classification:

- * Vle, nonirrigated

Main soil limitations and hazards:

- * soil blowing
- * erosion by water
- * slope
- * limited available water capacity
- * surface coarse fragments
- * lime content

Musci: shell i

... ..

$\frac{1}{2} \times \frac{1}{2}$ $\frac{1}{2} \times \frac{1}{2}$ $\frac{1}{2} \times \frac{1}{2}$ $\frac{1}{2} \times \frac{1}{2}$

[illegible]

2004.04.05

1990

2-51424

* SURFACE COARSE FRAGMENTS

Table contents

Rangeland

Crago and Musselshell soils

Range sites:

* Sulfur-rich phase. 10- to 14-inch precipitation zone

Windbreaks

Crago and Musselshell soils

Wardens: sustainability group - 6 to 10 percent slopes:

22

4. children in table IV group - 15 to 25 percent slopes:

241

LABORATORY REPORT

TO:
ADDRESS:

Hydrometals
Steve Davis
3737 Airport Road
Helena, MT 59601

LAB NO.: 91-00557
DATE: 09/02/91 GL

NATURAL GAS ANALYSIS REPORT

Helena Landfill
HL3107-1A

Sampled 07/23/91 @ 0330
Submitted 07/25/91

CHROMATOGRAPH ANALYSIS

Concentration

Volume %

APPENDIX E.

METHANE INFORMATION

Oxygen	20.86	21
Nitrogen	77.72	78
Carbon dioxide	1.42	1
Hydrogen Sulfide	0.50	
Methane	0.00	
Ethane	0.00	
Propane	0.00	
Isobutane	0.00	
N-Butane	0.00	
Isopentane	0.00	
N-Pentane	0.00	
Hexanes plus	0.00	
Totals	100.00	

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Steve Downs
2727 Airport Road
Helena, MT 59601

LAB NO.: 91-26557
DATE: 08/02/91 da

NATURAL GAS ANALYSIS REPORT

Helena Landfill
HL9107-1A
Sampled 07/23/91 @ 0930
Submitted 07/25/91

CHROMATOGRAPH ANALYSIS

<u>Constituent</u>	<u>Volume, %</u>
Oxygen	20.86 21
Nitrogen	77.72 78
Carbon dioxide	1.12 1
Hydrogen Sulfide	
Methane	0.30
Ethane	0.00
Propane	0.00
Isobutane	0.00
N-Butane	0.00
Isopentane	0.00
N-Pentane	0.00
Hexanes plus	0.00
Totals	100.00

Dear Sir:

The following letter is to inform you of a condition at and peripheral to the City of Helena Landfill. During the natural breakdown of landfilled refuse, methane gas is formed. This methane can create explosive conditions and a low oxygen environment in sub-grade structures and excavations. Even though the levels of methane do not appear to be of concern in the landfill area, the City of Helena believes you should be aware of the potential problem and exercise pre-cautionary measures when servicing any underground utilities or excavating in the vicinity of the landfill.

In the recent past, the City has monitored and sampled in numerous areas in and near the landfill. The results indicate that concentrations in monitoring wells and structures are well below the lower explosive limit and that there are low concentrations of methane throughout a zone. **APPENDIX E. METHANE INFORMATION** However, we recommend monitoring oxygen and methane levels in any excavations or when working in any sub-grade structures in or directly adjacent to the City landfill.

The City of Helena Fire Department is continuing to closely monitor this situation and should you have any questions we would be glad to be of assistance.

Sincerely,

Richard Michel, P.E.
Director of Public Works

RHM:ad

Dear Sir:

The following letter is to inform you of a condition at and peripheral to the City of Helena Landfill. During the natural breakdown of landfilled refuse, methane gas is formed. This methane can create explosive conditions and a low oxygen environment in sub-grade structures and excavations. Even though the levels of methane do not appear to be of concern in the landfill area, the City of Helena believes you should be aware of the potential problem and exercise precautionary measures when servicing any underground utilities or excavating in the vicinity of the landfill.

In the recent past, the City has monitored and sampled in numerous areas in and near the landfill. The results indicate that methane concentrations in monitoring wells and structures are well below the lower explosive limit and that these low concentrations of methane diminish a short distance from the landfilled area. However, we recommend monitoring oxygen and methane levels in any excavations, or when working in any sub-grade structures in or directly adjacent to the City landfill.

The City of Helena Fire Department is continuing to closely monitor this situation and should you have any questions we would be glad to be of assistance.

Sincerely,

Richard Nisbet, P.E.
Director of Public Works

RN:kab

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Steve Downs
2727 Airport Road
Helena, MT 59601

LAB NO.: 91-26557
DATE: 08/02/91 da

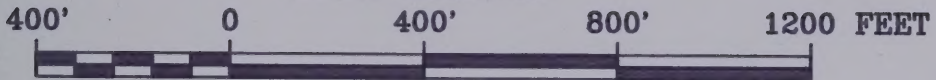
NATURAL GAS ANALYSIS REPORT

Helena Landfill
HL9107-1A
Sampled 07/23/91 @ 0930
Submitted 07/25/91

CHROMATOGRAPH ANALYSIS**Constituent****Volume, %**

Oxygen	20.86 21
Nitrogen	77.72 78
Carbon dioxide	1.12 1
Hydrogen Sulfide	0.30
Methane	0.00
Ethane	0.00
Propane	0.00
Isobutane	0.00
N-Butane	0.00
Isopentane	0.00
N-Pentane	0.00
Hexanes plus	0.00
Totals	100.00

Scale



Project:

City of Helena Landfill

Sheet Title:

Domestic and Monitoring Well
Locations and Potentiometric
Contour Map for Spring, 1992

Drawn: GLF, JHD

Checked: SD

Approved: MW

Date: 7/20/92

Rev. 4/9/93

Hydrometrics, Inc.

Consulting Scientists and Engineers
2727 Airport Road
Helena, Montana 59601
(406) 443-4150

EXHIBIT

1

HLF2392F



BILL ROBERTS
MUNICIPAL GOLF
COURSE

BATCH
FIELDS

ELK RIVER
CONCRETE

MONTANA RAIL LINK

LANDELL OFFICE

CARROLL
COLLEGE

RALPH ST

HENRY ST

PARK AVE

FRONT ST

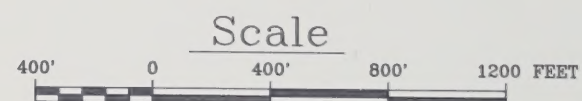
R4W

R3W



Legend

- HL-2 ■ Piezometer
- 83-5 Abandoned Monitoring Well
- 83-6 ● Monitoring Well
- I-6 ▲ Irrigation Well
- 80 □ Domestic Well
- Infiltration Gallery
- Potentiometric Contour (May, 1992)
(Dashed Where Inferred)
- Approx. Location Of Storm Drain
- Approx. Extent Of City Of Helena Landfill



Project:
City of Helena Landfill

Sheet Title:
Domestic and Monitoring Well
Locations and Potentiometric
Contour Map for Spring, 1992

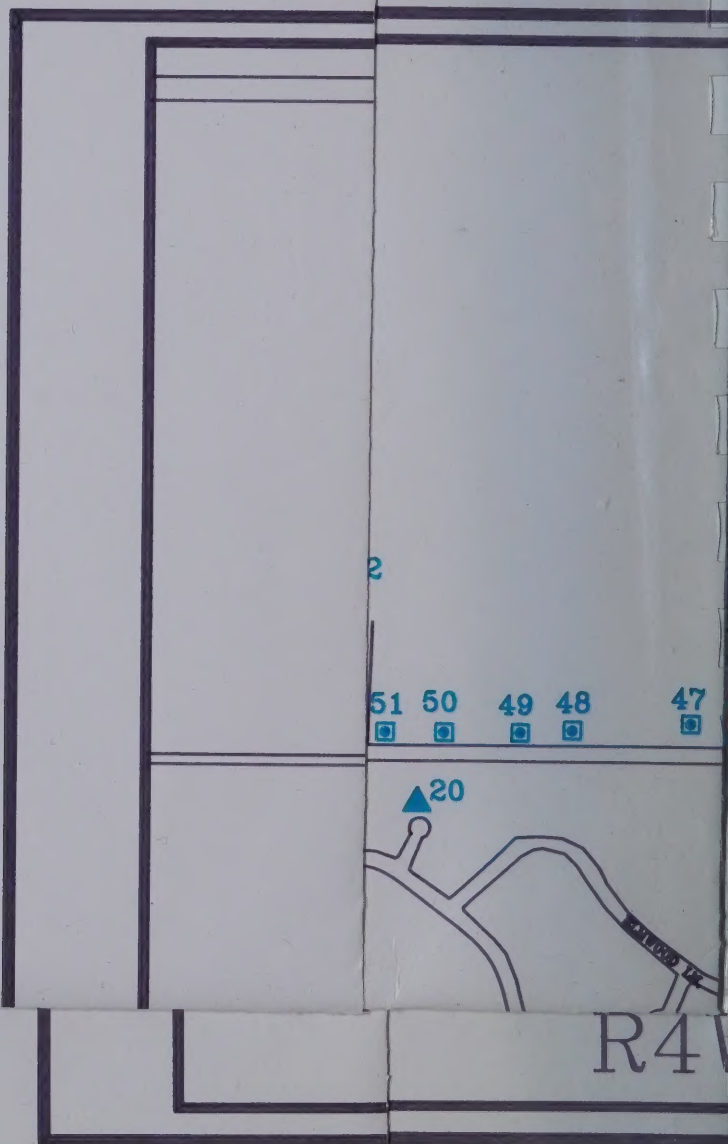
Hydrometrics, Inc.
Consulting Scientists and Engineers
2727 Airport Road
Helena, Montana 59601
(406) 443-4150

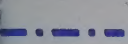
Drawn: GLF, JHD
Checked: SD
Approved: MW
Date: 7/20/92
Rev. 4/9/93

EXHIBIT **1**
HLF2392F

Approx. Extent Of City Of Helena Landfill

Approx. Location Of Storm Drain



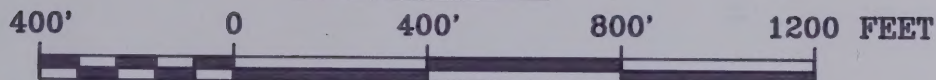


Approx. Location Of Storm Drain



Approx. Extent Of City Of Helena Landfill

Scale



Project:

City of Helena Landfill

Sheet Title:

Approximate Extent Of
Dichlorodifluoromethane In
Groundwater - Spring 1992

Drawn: GLF, JHD

Checked: SD

Approved: MW

Date: 7/27/92

Rev.: 11/03/92

Hydrometrics, Inc.

Consulting Scientists and Engineers
2727 Airport Road
Helena, Montana 59601
(406) 443-4150

EXHIBIT

2

HLF2492F

2.9

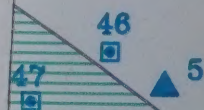
Potentiometric Contour
(Dashed Where Inferred)

Concentration of Dichlorodifluoromethane
Parts Per Billion (ppb) (Isocentration
Line Dashed Where Inferred)

1.0 - 4.0 Dichlorodifluoromethane

4.0 - 10.0 Dichlorodifluoromethane

>10 Dichlorodifluoromethane





April 8, 1993

RECEIVED

APR 09 1993

Mr. James Wilbur
MT Dept. Health and Env. Sciences
Solid Waste Program
Cogswell Building
Helena, Montana 59620

MONTANA DEPARTMENT OF HEALTH
AND ENVIRONMENTAL SCIENCE

RE: Helena Landfill Drainage Channel Design

Dear Jim:

Enclosed for the MDHES' review is the "Revised Helena Landfill Closure Plan" this plan incorporates the changes which the MDHES requested in their comments on the original closure plan as well as addresses the additional cover requirements of Subtitle D. The revised sections of the plan have been redlined to assist you during your review. As you know, the City is committed to closing the landfill this summer, so please contact us at any time during your review if we can answer any questions which may help expedite the review process.

Thank you for your continued cooperation on this project. If you have any questions, please call anytime.

Sincerely,

Steven K. Downs
Senior Engineer

c: Mr. Dick Nisbet, City of Helena, Public Works Director
Mr. Ted Hill, City of Helena, Environmental Engineer

File CDBG

DEPARTMENT OF ENVIRONMENTAL QUALITY

AND
Helena I.F. Closure



MARC RACICOT, GOVERNOR

STATE OF MONTANA

(406) 444-2544

(406)-444-5263

PO BOX 200901
HELENA, MONTANA 59620-0901

December 30, 1998

Lewis and Clark County
Attn: Randy Lilje
City/County Building
316 North Park
P.O. Box 1724
Helena, MT 59624

Pat -
Info -
Low

Dear Mr. Lilje:

RE: CTEP Funded Bicycle-Pedestrian Path Project

County	L & C
Facility & #	Helena 90
Closure	Landfarm
Finan Assur	Liner
GW Corr Meas	Methane
GW Monitoring	O & M
GW Reports	Run - On
Inspections	
Other:	

The environmental health considerations administered by the Montana Department of Environmental Quality (DEQ) have been reviewed for a proposal by Lewis and Clark County to use Community Transportation Enhancement Program (CTEP) and Simms Recreational Trails Program funds for the creation of a bicycle-pedestrian path project through Nature Park to connect with North Main and Benton Avenue.

Water Quality

The Montana Pollutant Discharge Elimination System General Discharge Permit for Storm Water Associated with Construction Activity applies to all areas of the State of Montana except Indian Reservations.

The permit regulates the discharge of pollutants associated with construction activities in storm water to state surface waters. Discharge of pollutants means *any addition of any pollutant or combination of pollutants to state waters from any point source*. Sediment is a pollutant, as are oil and grease, fuels, fertilizers, etc. Storm water means *storm water runoff, snow melt runoff, and surface runoff and drainage*. State waters means *any body of water, irrigation system, or drainage system, either surface or underground*.

The permit covers construction activities including clearing, grading, and excavating of a total of five (5) or more acres that is a part of a common plan for development or sale or greater than one acre of contiguous clearing, grading and excavating, any part of which is located within one hundred (100) feet of state waters.

A proposed construction project that meets the above criteria must submit to the PCD (444-5329) an application for coverage under the general discharge permit, a site-specific erosion control plan, and the appropriate application fee at least thirty (30) days prior to construction taking place.

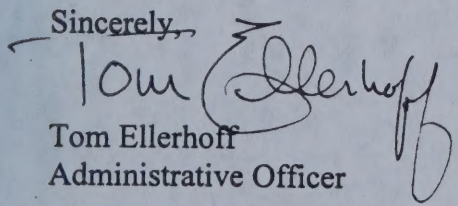
Solid Waste

The following is a summary of comments and recommendations regarding possible solid and hazardous waste considerations:

- ▶ All Group II material generated during the project, such as waste insulation, plastic, and metal, should be reused, recycled, or disposed of in a licensed Class II (municipal) landfill or incinerator. The Lewis and Clark County Class II Landfill could accept waste from this project without significantly impacting its normal operating procedures or the environment. The Permitting and Compliance Division (PCD) recommends getting the operator's approval before taking material to any disposal site.
- ▶ Untreated wood waste and rebar-free concrete are considered Group III material and should be reused, recycled, or disposed of in either a licensed Class II landfill.
- ▶ Untreated wood waste and brush generated during this project could also be composted.
- ▶ Clean fill, such as soil, dirt, sand, gravel, rocks, and rebar-free concrete leftover from a project does not have to be placed in a licensed Class II or III landfill if it is emplaced free of charge to the person placing the fill. The clean fill has to be used to adjust or create topographic irregularities for agricultural or construction purposes (ARM 16.14.502(6)).
- ▶ Caution is advised if buried material is found during the project, as the material might be hazardous. If such a situation arises, the PCD should be contacted immediately.
- ▶ For safety purposes, the applicant should consider a contingency plan outlining how the applicant will handle potential situations where unknown material is found, who should be called, personal protection, appropriate response, etc.

If you have questions, please call: Fred Shewman, Water Protection Bureau, PCD, 444-5329, or Pat Crowley, Community Services Bureau, PCD, 444-5294.

Sincerely,


Tom Ellerhoff
Administrative Officer

cc: Director's Office
E. Hedlund, MDOT

MEMORANDUM

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NOV 13 1997

MONTANA

DEPT. OF ENVIRONMENTAL QUALITY
COMMUNITY SERVICES BUREAU

MAY 2, 1997

TO: CHUCK HANSON, CITY ENGINEER

FROM: DOUG KREBS, ENGINEERING MANAGER *AK*

SUBJECT: CITY OF HELENA FINAL LANDFILL CLOSURE PLAN

Hydrometrics, Inc. submitted the Helena Landfill Closure Plan to the Montana Department of Health and Environmental Sciences in September 1991. Hydrometrics, Inc. designed the Closure Plan to meet all requirements set forth by the State of Montana in the Administrative Rules of Montana, Title 16, Chapter 14-Solid Waste Management, Sub-chapter 5-Refuse Disposal; and Sub-chapter 7-Proposed Groundwater Monitoring Rules for Landfills in Montana.

The engineer designed the final cover for the City of Helena Landfill according to the State of Montana Class II Landfill Closure Requirements and Recommendations (April 3, 1991). Proposed future land use, maintenance and monitoring have all been considered in the final cover design.

Maronick Construction completed the final cover elevations corrections resulting from DEQ's spring of 1994 on site inspection in October 1995. The chronological sequence of the engineering staff involvement is on file in the engineering office.

City of Helena, Montana

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DEPT. OF ENVIRONMENTAL QUALITY
COMMUNITY SERVICES BUREAU

NEWSPAPER

NOV 13 1997

TO: [illegible]

FROM: [illegible]

SUBJECT: [illegible]

[illegible text block]

[illegible text block]

[illegible text block]

City of Helena, Montana

- 10-24-95 Completed Final Cover (Maronick Const)
- 9-26-95 Bluetopped ditch on So. Side
- 9-7-97 met w/ Gene & John of Helene Sand (Maronick)
& discussed scheduling of final cover
for landfill
- 5-19-94 met w/ Dale from SK const. & discussed remaining
cover needed
- 5-18-94 Field work measuring stock pile & later staff
meeting to discuss remaining cover
- 5-10-94 Ritchie worked on NEAD dug for final cover
- 5-9-94 measured slopes for seeding quantities
- 4-21-94 Staked ditch on So. Side
- 4-18-94 Began Total Sta. Sur. of landfill
- 4-14-94 Col'd quantity hauled from Site E
- 4-17-94 Began Staking final cover
- 1-19-94 Began Plotting X-sec. Site E
- 1-4-94 met / HFN, Willie concerning Scott Prindle's claim
- 11-16-93 X-sec. Site E. — Staked ditch on no-side landfill
- 11-4-93 X-sec Top of Clay
- 5-25-94 met w/ John Lingaffe concerning prop. trade for fill
- 5-26-95 met w/ John Steffek & discussed Lingaffe
- 10-28-93 Staked top of clay
- 10-27-93 met w/ Scott Prindle, Dong & Erick & discussed
problem w/ the \$350 / yd. price
- 10-21-93 Shaved Leroy of Sanitation whom to work on Slopes
- 10-13-93 met w/ Lisa Seleson, Griffith, Hansen, Prindle
Krebs about Leroy. Author not completing
contract
- 7-21-93 Staked top of Garbage w/ Becker

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MONTANA
DEPT. OF ENVIRONMENTAL QUALITY
COMMUNITY SERVICES BUREAU

MEMORANDUM

TO: Dick Nisbet
FROM: Bill Michalson *BM*
RE: Clay Cover Over Transfer Station Site
DATE: May 17, 1993

On Wednesday, May 12th, I met with Laura Dando of the State Solid and Hazardous Waste Bureau and excavated test holes to determine the depth of the clay cover. We drilled fourteen test holes, concentrating our efforts in the area that will be paved in the future. The access road that encompasses the entire site had approximately 4" too much clay. The interior roads leading in and out of the transfer station itself are covered with 18"-19" of clay.

I suggest that elevations be shot and staked for the actual road grade that encompasses this site and any additional material be moved to the ditch on the east side - as this is lacking in cover material. Any excess material should be worked up to the east slope over the area requiring 24" of clay cover.

cc: Doug Krebs
Frank Ritchie

NOV 12 1961

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UNITED STATES DEPARTMENT OF
COMMERCE

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NOV 13 1997

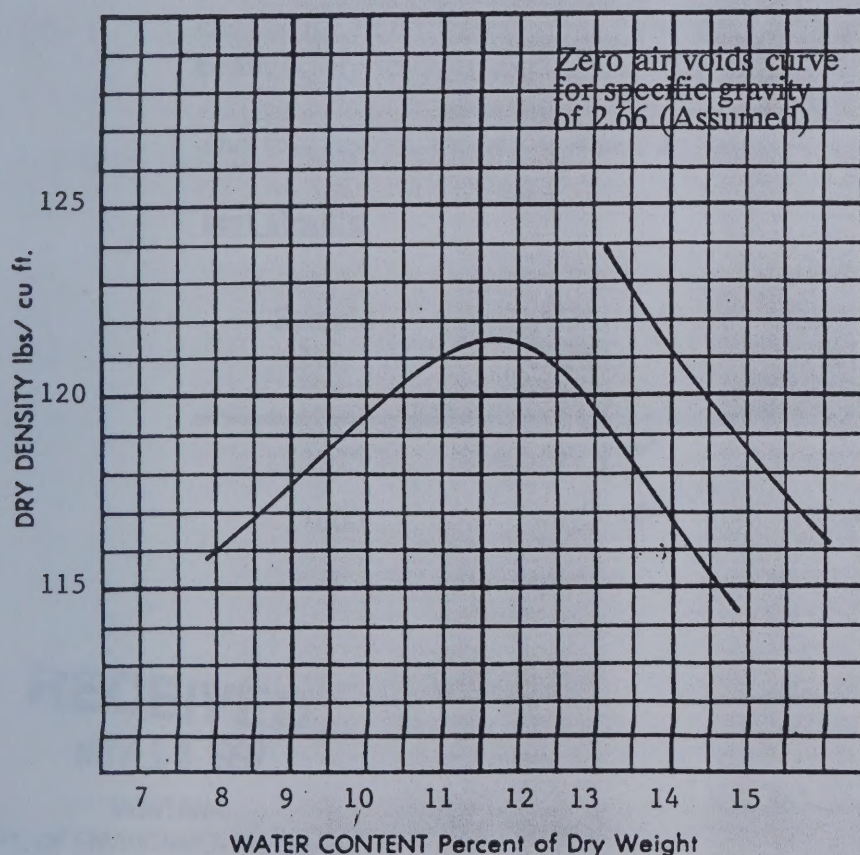
MONTANA

DEPT. OF ENVIRONMENTAL QUALITY
COMMUNITY SERVICES BUREAUREPORT TO: City of Helena
Attn: Mr. Doug Krebs, P.E.
316 North Park
Helena, MT 59623PROJECT: City of Helena Landfill
CONTRACTOR: N/R
SAMPLE LOCATION: West End

MATERIAL USE: Cover Material

**MOISTURE-DENSITY RELATIONSHIP
DATA SHEET**☐ HELENA
1610 B STREET
P. O. BOX 4699
HELENA, MT 59604
(406) 443-5210
FAX (406) 449-3729DATE: May 13, 1993
JOB NUMBER: 93-3481
SHEET: 1 OF 1
INVOICE NO.: 127771
LAB NO.: 11694
DATE SAMPLED: 05-03-93
DATE RECEIVED: 05-03-93
SAMPLED BY: E. JohnsonMECHANICAL ANALYSIS
SIZE % PASS SPECS.N
O
T
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F
O
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M
E
D

MOISTURE-DENSITY RELATIONSHIP

UNIFIED CLASSIFICATION (ASTM D2488)
Clayey Sand with Gravel
SPECIFIC GRAVITY: 2.66 (Assumed)
LIQUID LIMIT: Not Performed
PLASTICITY INDEX: Not PerformedTEST PROCEDURE ASTM D698-B
MAX. DENSITY: 121.6 pcf
OPT. MOIST.: 11.7%
RAMMER TYPE: Manual
PREPARATION PROCEDURE: Wet
PENETRATION RESIS.: N/A

REMARKS:

DISTRIBUTION:

Reviewed By:

Jeremiah B. Bowser

RECEIVED
NOV 13 1991

DEPT. OF ENVIRONMENTAL QUALITY
COMMUNITY SERVICES BUREAU

REPORT NO. C-10-10-10-10
VOLUME NO. 10-10-10-10
DATE: 10-10-10-10
BY: 10-10-10-10

PROJECT: C-10-10-10-10
CONTRACTOR: 10-10-10-10
SUBMITTER: 10-10-10-10

ANALYST: 10-10-10-10

MONITORING-CEMENTY DATA SHEET
DATASHEET

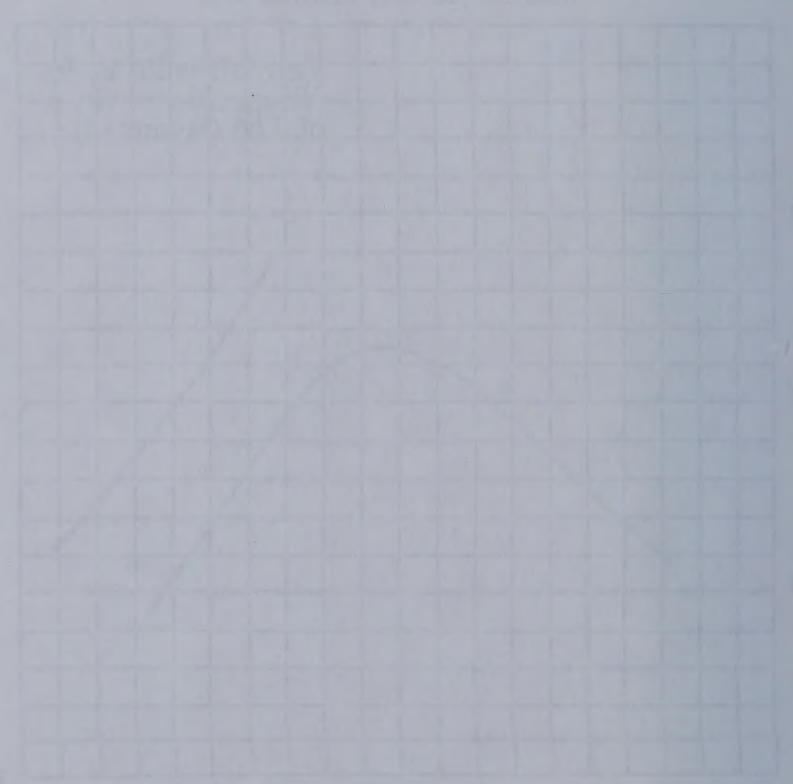
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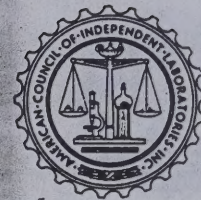
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1. MONITORING-CEMENTY DATA SHEET



1610 B STREET
P. O. BOX 4699
HELENA, MT 59604
(406) 443-5210
FAX (406) 449-3729

REPORT TO: City of Helena
Attn: Mr. Doug Krebs, P.E.
316 North Park
Helena, MT 59623

DATE: May 11, 1993
JOB NUMBER: 93-3481
SHEET: 1 OF 1
INVOICE NO.: 127768

REPORT OF: Laboratory Analysis of Soils, City of Helena Landfill

SAMPLE IDENTIFICATION:

On April 12 and 16, 1993 our personnel sampled soil imported from site "E" landfill for use as cover material at the City of Helena landfill. We performed moisture-density one point checks for determining the appropriate ASTM D698 curve used for performing hydraulic conductivity tests in accordance with ASTM D5084.

The test results are summarized as follows:

Test Results

Sample No.	Dry Density (pcf)	Moisture Content (%)	Hydraulic Gradient	Hydraulic Conductivity (cm/sec)
11595	91.6 <i>110.2</i>	16.8	18.46	5.9×10^{-6}
11600	82.5 <i>108.1/5/6.5</i>	23.6	18.46	9.9×10^{-7}

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MONTANA

DEPT. OF ENVIRONMENTAL QUALITY
COMMUNITY SERVICES BUREAU

Reviewed By:

Jeremiah B. Bowser

Distribution:



TEST REPORT

Montana Department of Environmental Quality

A number to the [] can be found in the []

DATE: 11/1/87
BY: []
FOR: []
TEST: []
ANALYST: []

DATE: 11/1/87
BY: []
FOR: []
TEST: []
ANALYST: []

REPORT TO: []
FROM: []
TEST: []
ANALYST: []

REPORT ON: []

ANALYSIS INFORMATION

On 11/1/87, the [] was analyzed for [] and [] in the [] area. The results are as follows:

The test results are summarized as follows:

Test Results

Parameter	Result	Unit
Lead	0.05	mg/L
Copper	0.02	mg/L

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NOV 1 1987

DEPT. OF ENVIRONMENTAL QUALITY
COMMUNITY SERVICES BUREAU

Signature: []

Date: []



1610 B STREET
P. O. BOX 4699
HELENA, MT 59604
(406) 443-5210
FAX (406) 449-3729

REPORT TO: City of Helena
Attn: Mr. Doug Krebs, P.E.
316 North Park
Helena, MT 59623

DATE: May 17, 1993
JOB NUMBER: 93-3481
SHEET: 1 OF 2
INVOICE NO.: 127772

REPORT OF: Tests of compacted cover material for City of Helena Landfill; Helena, MT

SAMPLE IDENTIFICATION:

Attached are the results of field density tests performed on the above-referenced project on the dates and at the locations shown. Unless otherwise noted, our personnel utilized the nuclear densometer method of testing in accordance with ASTM D2922. In accordance with our quality control procedures, occasional routine correlation tests are performed using sand cone methods in accordance with ASTM D1556.

Contractor:

Test Locations were selected by: Chen-Northern personnel at random locations

Minimum required in-place density: 85% of the Maximum Laboratory Density

Maximum density as determined by: ASTM D698

Remarks:

Reviewed By:

Jeremiah B. Bowser

Distribution:

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MONTANA

DEPT. OF ENVIRONMENTAL QUALITY
COMMUNITY SERVICES BUREAU



TECHNICAL REPORT

Chen-Jarvis, Inc.

A member of the (LIFE) Group, Inc.

Who's Who
P.O. Box
Hickory, NC 28127
(704) 325-1111
Fax (704) 325-1112

Date: May 17, 1991
Drawing: V-04821
Sheet: 1 of 2
Project No.: 12-771

Project No.:
City of Hickory
Name: Mr. Doug Kiser, PE
301 North Park
Hickory, NC 28127

Title of proposed work: Hickory, NC City of Hickory, Hickory, NC

SAMPLE DESCRIPTION

Attached are the results of the analysis performed on the above-referenced project on the date that the laboratory received the sample. The analysis was performed on the sample in accordance with the test method specified in the project description. The results of the analysis are presented in the attached report.

Test locations were selected by:
Minimum required - Class 1 only
ASTM D69
City of Hickory, Hickory, NC
City of Hickory, Hickory, NC

Prepared by: D. A. B. B.

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NOV 13 1991
DEPT. OF ENVIRONMENTAL QUALITY
COMMUNITY SERVICES BUREAU

City of Helena
Attn: Mr. Doug Krebs, P.E.
316 North Park
Helena, MT 59623

May 17, 1993
93-3481
Sheet 2 of 2
127772

City of Helena Landfill; Helena, MT

TEST RESULTS:

Test Date	Lab No.	Field Moisture Content, %	Field Dry Density, pcf	Maximum Lab Dry Density, pcf	Percent of Maximum Obtained
05-03-93	11680	10.6	118.7	121.6 ^(a)	97.6
Southwest corner area, first lift					
05-03-93	11681	10.6	122.1	121.6 ^(a)	100.4
Center of North end, first lift					
05-03-93	11682	14.0	108.4	121.6 ^(a)	89.1
Northeast corner area, first lift					
05-03-93	11683	12.1	110.8	121.6 ^(a)	91.1
Southeast corner area, first lift					
05-03-93	11684	10.4	121.1	121.6 ^(a)	99.6
Center of South end, first lift					

(a) MD Curve No. 11694 (Maximum Density 121.6 pcf and Optimum Moisture 11.7%)

May 17, 1963
 63-2481
 Report of
 12-772

City of Boston
 315 North Street
 Boston, MA 02110

City of Boston, 1200th Street, MA

TEST RESULTS

Test Date	Lab No	Station	Field	Remarks	Remarks
05-07-63	11586	106	106	106	106
05-07-63	11587	106	106	106	106
05-07-63	11588	106	106	106	106
05-07-63	11589	106	106	106	106
05-07-63	11590	106	106	106	106
05-07-63	11591	106	106	106	106
05-07-63	11592	106	106	106	106
05-07-63	11593	106	106	106	106
05-07-63	11594	106	106	106	106
05-07-63	11595	106	106	106	106
05-07-63	11596	106	106	106	106
05-07-63	11597	106	106	106	106
05-07-63	11598	106	106	106	106
05-07-63	11599	106	106	106	106
05-07-63	11600	106	106	106	106

(a) 1200 Curve No. 11586 (Maximum Density 12.5 and Optimum Moisture 11.5%)

Chen Northern, Inc.

PROJECT REPORT

Project City Landfill Job No. 93-3481

Client City of Helena Date 05-03-93

Contractor _____ Report No. _____

Feature _____ Sheet _____ of _____

Weather _____ Min. Temp. _____ Max. Temp. _____ Work Period 3:00 A.M. to 4:30 P.M.

Personnel	Position	Mileage	Total Hours
<u>E. Johnson</u>	<u>LET</u>	_____	_____
_____	_____	_____	_____

NARRATIVE

- Performed 5 in-place field density tests on 1st lift of Fill material imported from site "E" for use as cover material City of Helena Landfill. In-place dry density values were higher than those on the M-D curves supplied from site "E". Dry density results were significantly higher in ^{west} end of landfill. One soil sample was taken on west end for testing a new M-D determination.

Preliminary observations and/or Test Results verbally reported to: _____

Approved _____ Date _____ Prepared By _____

File: Helena I.F.
L+C Conty

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SEP 08 1997

MONTANA
DEPT. OF ENVIRONMENTAL QUALITY
COMMUNITY SERVICES BUREAU

Methane
G.W. Corr
Measures

MEMORANDUM

TO: Unofficial Sports Council Members
Centennial Park Stakeholders

FROM: Randy Lilje, Director of Parks and Recreation

RE: Meetings on Sports Fields Plans

DATE: September 5, 1997

RL

The sports council and Centennial Park stakeholders will be meeting Thursday, September 11 at noon at the Mae Butler Center conference room, 55 South Rodney. The meeting will be to discuss Carl Thuesen's preliminary master plan for Centennial Park, the preliminary plan for Northwest Park, and Helena Youth Soccer Association's plans for the complex on the airport grounds. Please bring the most recent draft of the Centennial Park plan.

ALSO, please mark your calendars now for a meeting with Carl Thuesen on Thursday, September 18, 7 P.M., room 326 of the City-County Building. This will be a public meeting where Carl will discuss his work to this point.

If you have any questions or concerns, you can reach me at 447-8463.

c Open Space Bond Advisory Committee

Ken K To attend

Pat C.

County	<i>Lewis & Clark</i>
Facility & #	<i>Helena 90</i>
Closure	Landfarm
Finan Assur	Liner
GW Corr Meas	Methane
GW Monitoring	O & M
GW Reports	Run - On
Inspections	
Other:	

2-5

City of Helena, Montana

File Helms
100-100000

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JAN 10 1967
U.S. DEPT. OF JUSTICE
FEDERAL BUREAU OF INVESTIGATION

MEMORANDUM

TO: SAC, NEW YORK
FROM: SAC, NEW YORK
SUBJECT: [Illegible]
DATE: 1/10/67

Mr.

The subject of this report is [illegible] who was born [illegible] and is currently residing at [illegible] New York City. The subject was interviewed on [illegible] and the following information was obtained: [illegible] The subject is a [illegible] and has been employed by [illegible] for [illegible] years. The subject has no criminal record and is not currently under any investigation. The subject is a [illegible] and is not a member of any organization. The subject is not a threat to the national security and is not a member of any subversive organization. The subject is not a threat to the national security and is not a member of any subversive organization. The subject is not a threat to the national security and is not a member of any subversive organization.

Very truly yours,
[Signature]
FBI

City of Helena, Montana

Groundwater Corr. Measures
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APR 08 1997

MONTANA
DEPT. OF ENVIRONMENTAL QUALITY
COMMUNITY SERVICES BUREAUMEMORANDUM

TO: Centennial Park Stakeholders Group

FROM: Randy Lilje, Director of Parks and Recreation *RL*

RE: Upcoming Meeting with Consultant

DATE: April 4, 1997

Carl Thuesen, the consultant who is working on the Centennial Park development plan, will be in Helena to meet with stakeholders on Thursday, April 10. The meeting starts at 7 P.M. at Carroll College in room 106 of O'Connell Hall. O'Connell Hall is the building that faces Benton Avenue with St. Charles up high in the background. Park on Benton and go in the front door of O'Connell.

Carl will be wanting to hear from interested groups about programming, design standards, what is needed/wanted--a general laundry list of what people would like to see developed in the area.

Please have your concerns prepared so there will be ample time for everyone. If you need further information, please call my office at 447-8463.

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APR 8 1987

DEPT. OF ENVIRONMENTAL QUALITY
COMMUNITY SERVICES BUREAU

MEMORANDUM

TO: Environmental Policy Development Group

FROM: Deputy Director of Policy and Administration

SUBJECT: Upcoming Meeting with Consultants

DATE: 4/7/87

On Thursday, the consultant who is working on the Environmental Policy Development Group will be in Helena and will meet with the group on Thursday, April 9. The meeting will be at 9:00 A.M. at Carroll College in room 104 of Carroll Hall. I would like to see the consultant first before he comes to the meeting. Please let me know if you can meet with him on Wednesday, April 8, at the same time or at a different time.

It will be useful to have some interested groups about the project, develop standards, what is needed - a general meeting of that nature would like to see developed in the future.

Please have your committee prepared on their will be April 8th for the meeting. If you need further information, please call me at 444-4444.

DEPARTMENT OF
HEALTH AND ENVIRONMENTAL SCIENCES

Solid and Hazardous Waste Bureau

Solid Waste Program

MARC RACICOT, GOVERNOR (406) 444-1430

FAX # (406) 444-1499



STATE OF MONTANA

OFFICE 836 Front Street
LOCATION Helena, Montana

MAILING PO BOX 200901
ADDRESS: Helena, MT 59620-0901

November 4, 1993

Richard A. Nisbet
Director of Public Works
City-County Building
316 North Park Avenue
Helena, Montana 59623

SUBJECT: Landscaping Activities at the City of Helena Class II Landfill

Dear Mr. Nisbet:

On November 1, 1993, James Wilbur, Patrick Crowley, and I visited the new transfer station on its first day of operation. We were disturbed to see trees planted around the facility, especially those trees planted on top of the old landfill. There was also a trench being dug for an apparent irrigation system next to the diversion ditch that lies north-south across the old landfill. We also witnessed the workers unearthing solid waste as they dug the trench. By planting trees and installing an irrigation system, the City of Helena is in violation of the rules and regulations governing solid waste disposal in Montana, as well as the closure plan approved by the Montana Department of Health and Environmental Sciences. **Any change to an approved closure plan has to be approved of by the Department prior to alteration.** It is very important that the integrity of the final cover of the old City of Helena Class II Landfill is not compromised. And, based on the location of numerous trees and the irrigation trench, this may have already occurred.

The planting of trees and the installation of an irrigation system was discussed in a letter addressed to you back on October 25, 1991 (copy enclosed), as well as in the City of Helena Transfer Station Environmental Assessment (copy enclosed). The Department approved of the planting of only shallow-rooted species on the old landfill only as long as the City installed at least three (3) feet of top soil in conjunction with the minimum two (2) feet of required cover. The Department also requested information on the possible root depths for each species to be planted so that the potential for compromising the integrity of the final cover would be minimal. This information had to be submitted to this office for approval. To my knowledge, the Department never received the forementioned information, nor did we approve of the planting of trees on the old landfill.

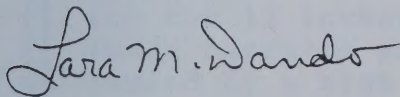
Trees have the potential to harm the integrity of the cover material by acting as a pathway for moisture infiltration. The plants may also absorb moisture (leachate) and methane gas generated inside the old cells, which could cause a high mortality rate among the trees.

The installation of an irrigation system on top of the old landfill has not been approved of by this office. An irrigation system was discussed in the Environmental Assessment. However, before the system could be installed, a soil moisture plan had to be submitted and approved by the Department. To my knowledge, such a plan was never submitted or approved. In the event that a ground water corrective action plan is required for the City of Helena Class II Landfill, the Department may require the plan to include changes to the existing irrigation system on closed areas of the landfill.

Therefore, in order for the City of Helena to come into compliance, a plan must be submitted to this office within **30 days** of receiving this letter. This plan should discuss the number and types of trees planted, their rooting depths, and the depth of final cover at each tree location situated on top of buried waste. Concurrently, the plan should include: (1) information on where the irrigation system is being installed; (2) how deep the irrigation system will be installed; and (3) a soil moisture plan similar to the one already approved for the Centennial Park area. Another option is for the City to consider removing trees planted directly on top of the final cover (two feet above waste) and the irrigation system from the old landfill area. The City should evaluate tree locations based on the potential problems indicated in this letter.

If you have any questions or comments, please do not hesitate to contact me.

Sincerely,



Lara M. Dando
Solid and Hazardous Waste Specialist

cc: Ted Hill, City of Helena, 316 North Park Avenue, Helena, MT 59623
Steven Downs, Hydrometrics, Inc., 2727 Airport Road, Helena, MT 59601
Lewis and Clark County Sanitarians' Office, City-County Building, P.O. Box 1723, Helena, MT 59624
Bill Verwolf, Helena City Manager, 316 North Park, Helena, MT 59624

Enclosures: Copy of 10/25/91 Letter, Transfer Station EA
F:\USR\CB5405\WP\CLOSURE\HELENA.CONTREES.N02

There have been many reports of the discovery of the remains of the missing men of the U.S.S. *Korean* in the waters of the Korean Peninsula. The reports have been made by the Korean people and by the United States Navy. The reports have been made by the Korean people and by the United States Navy.

The remains of the missing men of the U.S.S. *Korean* have been found in the waters of the Korean Peninsula. The remains have been found in the waters of the Korean Peninsula. The remains have been found in the waters of the Korean Peninsula. The remains have been found in the waters of the Korean Peninsula.

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If you have any information, please contact the nearest U.S. Navy office.

Sincerely,

John D. ...

John D. ...

John D. ...

John D. ...

RECEIVED

MEMORANDUM

NOV 22 1993

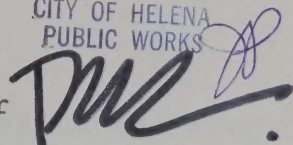
TO: Dick Nisbet, Director of Public Works

FROM: Randy Lilje, Community Facilities Director

RE: Recommended Plan for Plantings and Soil Moisture Control
at the City's Landfill and Transfer Station

DATE: November 18, 1993

CITY OF HELENA
PUBLIC WORKS



I have reviewed the November 4, 1993, letter from the Montana Department of Health and Environmental Sciences, Solid and Hazardous Waste Bureau regarding landscaping activities at the city's class II landfill. The following are my recommendations for the subject plan and the reasons for them.

The number and types of trees, shrubs, and grasses planted should be as noted on the landscape plan for the construction of the transfer station. The bureau has requested that rooting depths be attached to the different species of plants. However, I am not aware of any material that gives this information nor have I been able to locate it. Of course, any information giving depths of roots would serve only as an average under controlled conditions, probably optimum for root development.

What I have been able to find regarding the development of trees and shrubs in general is this: "The large majority of the roots are very shallow. The active and supportive root system is in the upper 10 to 12 inches of soil."¹ Also, it is very unlikely that the roots would even grow into the clay cap layer.

In bulletins No. 3 and 5 put out by the National Arbor Day Foundation, it states, "...roots need oxygen to grow, they don't normally grow in compacted, oxygen poor soil...." The (root) zone occupies a surprisingly large and shallow area, with most roots in the top 12 inches of soil,...their lower limit depends on where they reach barriers such as bedrock, a hard pan, or a lack of oxygen caused by a high water table or insufficient air passage through soil."²

It would seem to me that the clay cap installed over the landfill would serve as the barrier as described above. Krohe seems to agree with this premise in his article "Engineering Nature." In it Krohe describes what officials of both the state and city of New York found at the Fresh Kills landfill on Staten Island, one of the largest in the nation. Krohe describes "In the presence of skeptical state environmental regulators, they (New York landfill

City of Helena, Montana

MEMORANDUM

TO: Dick Nisdel, Director of Public Works

FROM: Randy Lyle, Community Facilities Director

SUBJECT: Recommended plan for "Islandia and Bell Islands Control at the City's Landfill and Transfer Station"

DATE: November 12, 1991

I have reviewed the November 4, 1991, letter from the Honorable Department of Health and Environmental Sciences, Solid and Hazardous Waste Bureau regarding landscaping activities at the city's Islandia landfill. The following are my recommendations for the subject plan and the reasons for them.

The number and types of trees, shrubs, and grasses planted should be as noted on the landscape plan for the development of the transfer station. The Bureau has requested that landscaping be done in the different areas of the site. However, I am not aware of any material that gives this information nor have I been able to locate it. Of course, any information giving details of costs would serve only as an average value. Controlled vegetation, probably suitable for road development.

What I have been able to find regarding the development of trees and shrubs in general is this: "The large majority of the roots are very shallow. The active and supportive root system is in the upper 10 to 12 inches of soil." Also, it is very unlikely that the roots would even grow into the clay cap layer.

In Bulletin No. 2 and 3 sent out by the National Arbor Day Foundation, it states: "... roots need oxygen to grow, they don't normally grow in compacted, oxygen poor soil..." The roots are typically a horizontally large and shallow tree, with most roots in the top 12 inches of soil. Their lower limit depends on where they reach barriers such as bedrock, a hard pan, or a lack of oxygen caused by a high water table or insufficient air passage through soil.

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Dick Nisbet

Page 2

November 18, 1993.

personnel) dug up healthy six-year old volunteer locusts and black cherries and found no roots had penetrated the cap (emphasis mine), even though some grew in only four inches of topsoil. Instead, the trees sent their roots laterally."¹

William Young, landscape architect for New York City's Department of Sanitation further reports, "Test plantings of trees at Fresh Kills landfill cause no damage to the clay cap. In fact, the roots of trees grow away from the cap. Trees don't want to go into a clay cap because it's the worst place for roots to go."⁴

The species of plants chosen for our landfill site were selected because they are native to the region and able to thrive under the extreme climatic and soil conditions of the Helena valley. These plants have all been known to grow in poor topsoil that is six inches or less in depth. With the clay cap, these roots should go nowhere near the garbage. However, if required, a layer of topsoil could be placed over the clay. I would recommend this layer be 6 to 12 inches maximum. Based on the above information, the three feet recommended by the Department is excessive and unwarranted.

The Department further requests information on where the irrigation system is being installed and how deep the system is installed. This information is all included within the landscape plans and specs for the construction of the transfer station. All irrigation lines are being installed relatively shallow, to my recollection, with the deepest being a maximum of 12 inches. And as you well know, a contractor is not going to dig deeper than he/she has to!

In my opinion, the soil moisture monitoring plan does not have to be anywhere near as complicated as the Department has required for Centennial Park. At Centennial Park with its nightly watering of turfgrass, I can understand some concern about the irrigation water possibly penetrating the cap into the garbage. However with all our watering, constant monitoring using a variety of methods, and a cover that is not as "tight" as the clay used on the last phase, we have yet to discover problems.

leachate generation + methane

In addition, the type of irrigation used at the transfer station will be drip. This will cut the water use up to 70 percent over a conventional system.

Therefore, I recommend determining the maximum water consumption required for a 24-hour period. Then the meter should be read daily to see if there are any unusually high increases indicating a possible break in a line. In addition, I would recommend monthly testing for the depth of moisture by use of a soil probe. If no

personnel) dug up healthy six-year old volunteer locusts and black cherries and found no roots had penetrated the cap (separate note). Even though some grew in only four inches of topsoil. Instead, the trees sent their roots laterally.

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In addition, the type of irrigation used at the transfer station will be drip. This will cut the water use up to 70 percent over a conventional system.

Therefore, I recommend determining the maximum water consumption required for a 14-hour period. Then the meter should be read daily to see if there are any unusually high increases indicating a possible break in a line. In addition, I would recommend monthly testing for the depth of moisture by use of a soil probe. If no

Dick Nisbet
Page 3
November 18, 1993

problems are observed the first year, then testing two or three times per year should be sufficient. In my opinion, a neutron probe really does not provide any more useable information than the common soil probe. The neutron probe is both costly and unnecessary.

In conclusion, the landscape plan specified in the transfer station construction documents is based on both our experience in the field and research from other areas. The above plan should adequately address the Department's concerns without adding undue effort and expense.

I am also attaching my memo to you dated 11-19-91 which addresses some of the other concerns the Department had.

attach.

¹Whitcomb, C. E., 1986, Landscape Plant Production, p. 291, 506

²Fazio, J. R., "How Roots Really Work," Tree City USA Bulletins No. 3 & 5

^{3,4}Krohe, J., "Engineering Nature," Landscape Architecture magazine, 10-93, p. 74, 75

pa/ck/lndscpng.mem/11-93

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Whitcomb, C. E., 1986, Landscape Plant Production, p. 131, 505
Kaiser, J. R., "How Roots Really Work," Tree City USA Bulletin
No. 3 & 5
Krahn, J., "Engineering Nature," Landscape Architecture magazine,
10-93, p. 74, 75

gylek\landscape.memo\11-93

DEPARTMENT OF
HEALTH AND ENVIRONMENTAL SCIENCES

Solid and Hazardous Waste Bureau

Solid Waste Program

MARC RACICOT, GOVERNOR (406) 444-1430

FAX # (406) 444-1499



STATE OF MONTANA

OFFICE 836 Front Street
LOCATION Helena, Montana

MAILING PO BOX 200901
ADDRESS: Helena, MT 59620-0901

October 18, 1993

Richard A. Nisbet
Director of Public Works
City of Helena
City-County Building
316 North Park Avenue
Helena, Montana 59623

SUBJECT: City of Helena Class II Landfill Inspection and Closure Plan Approval

Dear Mr. Nisbet:

The purpose of this letter is two fold: First, I would like to discuss the closure plans submitted to this office. Second, I would like to discuss my inspection of the City of Helena Class II Landfill and the City of Helena Transfer Station. The Montana Department of Health and Environmental Sciences has reviewed all information pertaining to the closure of the City of Helena Class II Landfill (license number 90) submitted by the City of Helena and Hydrometrics, Inc. After reviewing these plans, the Department has approved them. Once the two feet of clay has been applied to the more recent disposal areas and the City is ready to test its thickness, please notify me. In order to help verify the required 18 inch (minimum) infiltration layer, I want to be present when the test pits are dug. Also, let me remind you that at least six inches of earthen material capable of sustaining native plant growth is required as of October 9, 1993 (Administrative Rules of Montana 16.14.530(1)(a)(i)). If the City wants to use six inches of clay for this layer it must demonstrate that the clay can sustain plant life, as well as minimize erosion.

When all the closure work has been completed, please notify this office. The Department can then schedule a time when someone from this office can carry out a closure inspection of the site.

The methane monitoring program submitted in the *Revised Helena Landfill Closure Plan*, March 1993, by Hydrometrics, Inc. has also been approved. The only condition is that all sites listed in Table 6.3, page 44, as well as those sites illustrated in Figure 6.1, page 46, are monitored for methane quarterly, as indicated in the text.

The City of Helena Class II Landfill should meet the conditions discussed in the Department's "Closure Guidance Policy". This document defines requirements and recommendations for landfill

City of Helena
October 18, 1993
Page 2

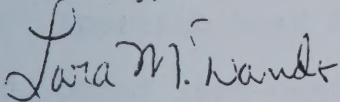
closures in Montana, including 40 CFR Part 258 (Subtitle D) requirements. Enclosed is a copy of the "Landfill Closure Review Sequence" which outlines the entire landfill closure approval process.

As you know, on October 13, 1993, I visited the City of Helena Class II Landfill and the City of Helena Transfer Station (license number 320). Thank you for showing me around both facilities. It was exciting to see the transfer station coming close to completion. Over all, the Class II landfill was looking very good. There were some areas, however, of inadequate cover that have to be corrected as soon as possible to prevent litter from spreading off-site. In regard to the transfer station, everything appears to be going according to the plans approved by the Department. The only thing that appears to be lacking was the retention pond, which you told me was to be constructed once some of the construction equipment and trailers are removed. Please notify us when the pond has been completed so that we can make proper notification in our files.

Enclosed you will find a copy of my inspection reports. An explanation of the rule that was violated can be found on a separate page. All violations need to be corrected in order to bring your operation into compliance.

Thank you again for your cooperation and assistance. If you have any questions or comments, please do not hesitate to contact me.

Sincerely,



Lara M. Dando
Solid and Hazardous Waste Specialist

cc: Ted Hill, City of Helena, 316 North Park Avenue, Helena, MT 59623
Steven Downs, Hydrometrics, Inc., 2727 Airport Road, Helena, MT 59601
Lewis and Clark County Sanitarians' Office, City-County Building, P.O. Box 1723, Helena, MT 59624

Enclosures: Landfill Closure Review Sequence, Inspection Reports
F:\USR\CB5405\WP\CLOSURE\HELENA.CO\CLOSAPPR.013

The first part of the report is a summary of the work done during the last year. It includes a list of the main results and a brief description of the methods used.

The second part of the report is a detailed description of the work done during the last year. It includes a list of the main results and a brief description of the methods used. The third part of the report is a discussion of the results and a comparison with the results of other workers.

The fourth part of the report is a conclusion and a list of references. The conclusion summarizes the main results and the references list the work of other workers.

The fifth part of the report is a list of references. The references list the work of other workers.

The sixth part of the report is a list of references. The references list the work of other workers.

The seventh part of the report is a list of references. The references list the work of other workers.

The eighth part of the report is a list of references. The references list the work of other workers.

The ninth part of the report is a list of references. The references list the work of other workers.

The tenth part of the report is a list of references. The references list the work of other workers.

SOLID WASTE MANAGEMENT SYSTEM INSPECTION REPORT

Name of Site: City of Helena Class II Landfill Date: October 13, 1993
 License #: 90 Class: II
 County: Lewis & Clark Location: Between Carroll College & Bill Roberts Golf Course
 Operator: City of Helena Address: 316 N. Park Ave. Helena, MT 59623
 Owner: Washington Corporation Address: P.O. Box 8182 Missoula, MT 59807

Violation
 Major Minor Comment

Violations explained on Page Two

1. Burning Controlled: YES
2. Disposal Site Properly Located: YES
3. Dumping Confined to a Manageable Area: YES
4. Refuse Properly Covered After Each Operating Day: XXX
5. Spreading and Compaction of Refuse Adequate: YES
6. Rodents and Insects Controlled: YES
7. Blowing Litter Controlled: YES
8. Access to Site Controlled: YES
9. Approach Road Properly Maintained: YES
10. Other (see next page): XXX

Control of Site: Yes Signs Yes Fences and/or Gates Yes Supervision

Equipment Visible On-Site: X Yes No

Type: Front-end Loader, Numerous Graders

Person(s) Seen: Richard Nisbet, City of Helena

Signature of Inspectors:

Lara M. Dando

Lara M. Dando
 Solid Waste Program

City of Helena Class II Landfill
Inspection Report
Page Two

MINOR VIOLATION:

#4) **Refuse Properly Covered After Each Operating Day** (Administrative Rules of Montana (ARM) 16.14.521(2)(a)) - All Class II sites using landfilling methods shall compact and cover solid waste with a layer of at least six (6) inches of approved cover material at the end of each operating day.

Upon inspection, I found an area on the south side of the landfill with insufficient cover. All Group II material is required to be covered with at least six inches of cover at the end of each operating day.

COMMENT:

#10) **Used Oil Tank** - The used oil collection tank at the entrance of the landfill was not locked at the time of my inspection. The tank lid was open, enabling anyone to dump anything into it. There were also several containers (including one antifreeze container) sitting by the tank. In order to prevent the used oil from being contaminated and thus creating a Subtitle C regulated hazardous waste, access to the tank must be controlled better.

The first part of the document is a letter from the President of the United States to the Congress. It is dated October 10, 1910. The letter is addressed to the House of Representatives and the Senate. It is signed by Woodrow Wilson.

The second part of the document is a letter from the Secretary of the United States to the Congress. It is dated October 10, 1910. The letter is addressed to the House of Representatives and the Senate. It is signed by James B. McLaughlin.

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SOLID WASTE MANAGEMENT SYSTEM INSPECTION REPORT

Name of Site: City of Helena Transfer Station Date: October 13, 1993

License #: 320

Class: II

County: Lewis & Clark

Location: Between Carroll
College & Bill Roberts Golf Course

Operator: City of Helena

Address: 316 N. Park Ave.
Helena, MT 59623

Owner: Washington Corporation

Address: P.O. Box 8182
Missoula, MT 59807

Violation	Major	Minor	Comment
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Violations explained on Page Two

1. Burning Controlled: YES
2. Disposal Site Properly Located: YES
3. Dumping Confined to a Manageable Area: YES
4. Refuse Properly Covered After Each
Operating Day: YES
5. Spreading and Compaction of Refuse Adequate: YES
6. Rodents and Insects Controlled: YES
7. Blowing Litter Controlled: YES
8. Access to Site Controlled: YES
9. Approach Road Properly Maintained: YES
10. Other (see next page): NONE

Control of Site: Yes Signs Yes Fences and/or Gates Yes Supervision

Equipment Visible On-Site: X Yes No

Type: Construction Equipment

Person(s) Seen: Richard Nisbet, City of Helena

Signature of Inspectors: Lara M. Dando

Lara M. Dando

Solid Waste Program

LANDFILL CLOSURE REVIEW SEQUENCE

- A Pre-closure discussions with licensee
- B Landfill Closure Plan received
- C Landfill Closure Plan review by DHES
- D Approval (or Disapproval) of Landfill Closure Plan Letter sent by DHES
- E DHES notified Landfill is in "interim closure"
- F DHES conducts Landfill Closure Inspection
- G Deficiency letter (DL) letter sent to licensee
- H Licensee responds to Deficiency letter (DL)
- I DHES conducts Landfill Closure Inspection
- J Landfill Closure Approval Letter sent by DHES to licensee
- K Licensee surrenders Solid Waste Management license to DHES
- L Landfill in final closure
- M Landfill put in "Final Closure" Files

Commissioners

Kay McKenna, Mayor
Margaret Crennen
Tom Huddleston
Colleen McCarthy
Mike Murray



City-County
Administration Building
316 North Park
Helena, MT 59623

Phone: 406/447-8000

William J. Verwolf
City Manager

City of Helena

June 30, 1993

RECEIVED

JUL 06 1993

Ms. Lara M. Dando
Environmental Specialist
Dept. of Health & Env. Sciences
Solid and Hazardous Waste Bureau
Solid Waste Program
836 Front Street
Helena, MT 59620-0901

MONTANA DEPARTMENT OF HEALTH
AND ENVIRONMENTAL SCIENCES
SOLID AND HAZARDOUS WASTE BUREAU

Re: City of Helena Landfill Closure

Dear Ms. Dando:

In your May 18, 1993 letter, you request additional information concerning the March 1993 closure plan. I will respond to each of the items listed in your letter.

1. I am attaching a copy of the abandonment description for well number 82-4 that was completed by Hydrometrics on May 5, 1992 when the well was abandoned.
2. The City does not have a map showing the waste cells in the Centennial Park area. As the City expands the potentiometric maps, this area will be included.
3. I gave this to you and Jim at our June 1 meeting.
4. I gave this to you and Jim at our June 1 meeting.

As for the storm drain channel design in your three questions, I respond as follows:

1. The attached map shows a portion of the Certificate of Survey where the ditch runs through and shows the storm drain easement. In the future, when we prepare the new maps for our ongoing monitoring program, we will add the ditch.
2. The canal was a requirement of your predecessor when we first started our closure plan. We anticipated that moving the discharge point of the storm drain further away from the landfill would reduce the potential for discharge water to mound back into the landfill wastes

Lara Dando
Helena Landfill Closure
June 30, 1993
Page 2

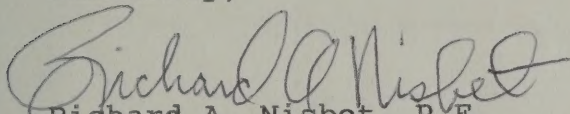
and produce leachate. City staff and solid waste officials felt that getting continual runoff would be in the City's best interests, and that is why we have been pursuing the channel lining.

3. I am not sure how we can monitor potential impacts other than our ongoing groundwater monitoring levels. Hydrometrics suggested that we may want to do some monitoring in the infiltration gallery well that the golf course uses to see if there has been any impact. However, since we have not been monitoring this in the past, I am not sure that this will be beneficial. The City would be receptive to any ideas that you might have for ongoing groundwater monitoring levels.

Regarding the pits that were dug on the landfill site, we have excavated numerous others on the main portion of the landfill. All of the tests exceeded the 24 inches of clay including the six additional inches for the final cover material. We are short on the north slope, and we are in the process of adding more clay. This will be completed once Rail Link buries the communication lines that are parallel to the railroad tracks. Once that is completed, we will do the additional testing necessary to assure that we have the required minimum cover.

I hope this information meets your requirements. I want to thank you for assisting the City in reviewing our final closure plan. If you have any questions or need any additional information, please don't hesitate to call me.

Sincerely,


Richard A. Nisbet, P.E.
Director of Public Works

RAN/skw

c Steve Downs
Ted Hill

lfclosur.ltr

Chloroform

1000

Hydrometrics, Inc.



2727 Airport Road • Helena, Montana 59601 • (406) 443-4150 • FAX (406) 443-4155

WELL ABANDONEMENT DESCRIPTION

Project: Helena Landfill

Well: 82-4

Date: 5-7-92

Personnel: BP,CO

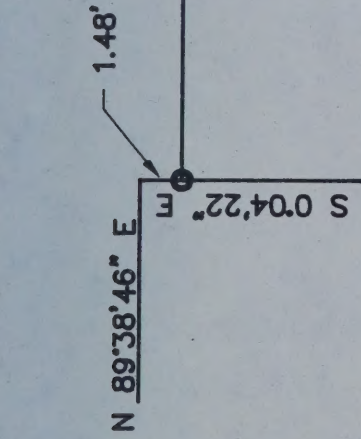
Abandonment Description:

Total depth and static water level were measured. TD was approximately 79 feet and SWL was about 60 feet. Bentonite pellets were slowly poured into well and annular space to provide a bentonite seal. Pellets were added very slowly and the progress up the well bore was measured frequently to ensure no bridging occurred. Pellets were added until the well bore and annulus was sealed to one foot above the water table. Three 50 pound buckets of pellets were used. Then one bag of bentonite crumbles and thirteen bags of bentonite chips were slowly added and hydrated with City tap water to seal the rest of the well to three feet below ground level. Frequent measurements were made to ensure that bridging did not occur. The top three feet of the steel casing was removed by the City and backfilled as per DNRC regulations.

All procedures and materials used were as required by DNRC regulations.

An easement to construct, operate and maintain a ditch to be described tract of land: A strip of land 40 feet wide being 20 centerline with the sides shortened or extended to end on the certificate of survey.

Centerline Description: Beginning at a point on the northern Railroad which bears N 66°50'00" W 11.30 ft. from the south ft.; thence, N 17°00'00" E 75.00 ft.; thence, N 8°00'00" W 17 R-1 which bears N 32°11'00" E 267.94 ft. from the southwest corner



DETAIL A
N.T.S.

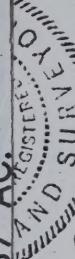
N 89°55'45" E 441.19'

ACCESS EASEMENT
APPURTENANT TO
TRACT A.

GRUBER

R1 ~ 4.387 AC.

CAP MARKED "ALBERT 5203S"



RIGHT

David M. Albert

CERTIFICATE OF COUNTY TREASURER

I, Kim Harris Treasurer of Lewis & Clark County, Montana do hereby certify that the accompanying plat has been duly examined and that no real property taxes assessed and levied on the land to be subdivided are delinquent.
(See 1888-1944-11-5-0000)

Dated this 17th day of January, 1992.

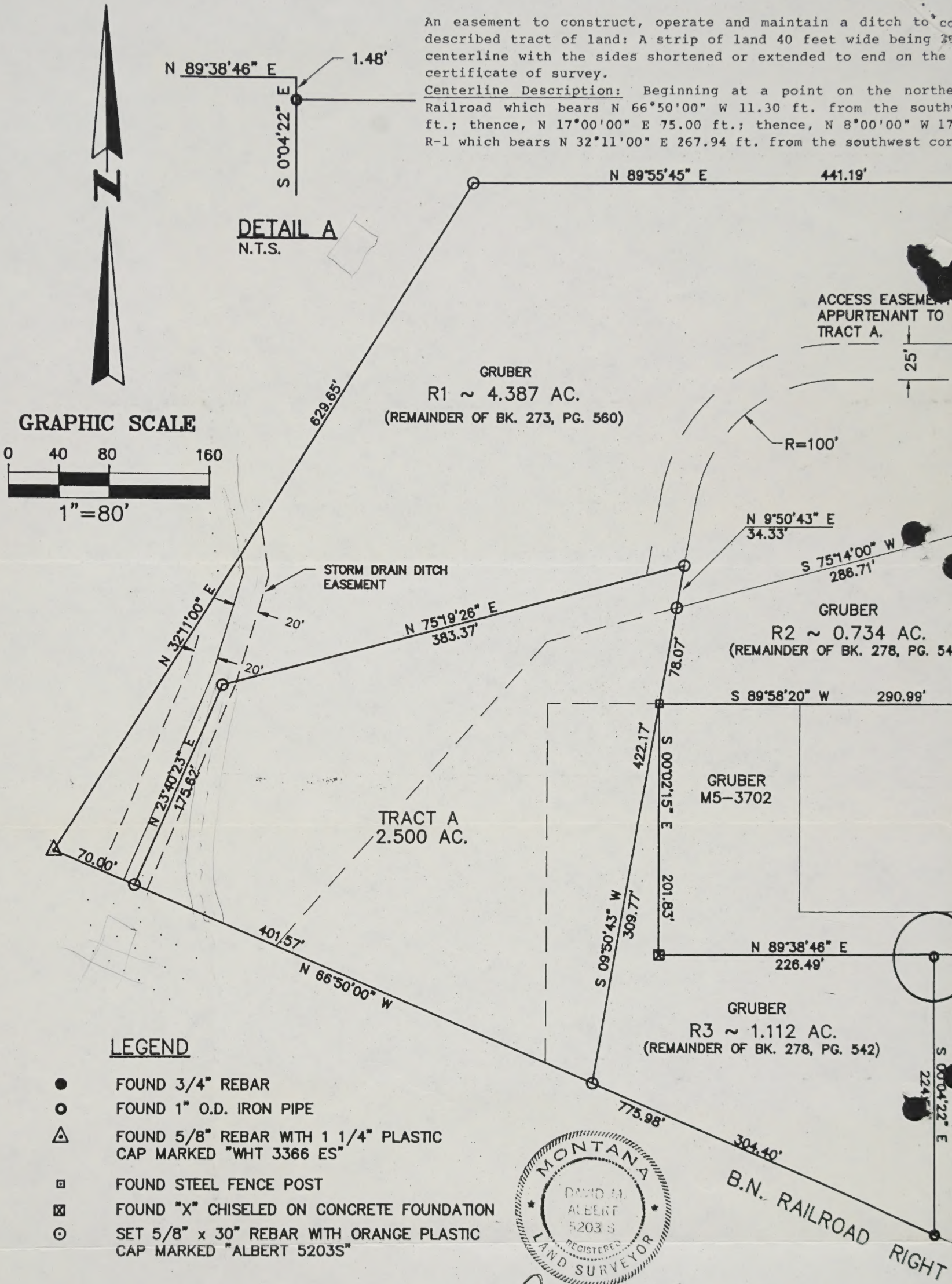
RK Jorgensen

CERTIFICATE

I, _____
Montana, do hereby certify that
office this _____ day of _____
of the Records of the County _____

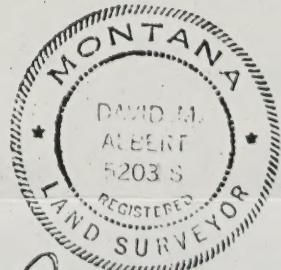
An easement to construct, operate and maintain a ditch to be described tract of land: A strip of land 40 feet wide being 30 centerline with the sides shortened or extended to end on the certificate of survey.

Centerline Description: Beginning at a point on the northern Railroad which bears N 66°50'00" W 11.30 ft. from the south ft.; thence, N 17°00'00" E 75.00 ft.; thence, N 8°00'00" W 17 R-1 which bears N 32°11'00" E 267.94 ft. from the southwest cor



LEGEND

- FOUND 3/4" REBAR
- FOUND 1" O.D. IRON PIPE
- △ FOUND 5/8" REBAR WITH 1 1/4" PLASTIC CAP MARKED "WHT 3366 ES"
- FOUND STEEL FENCE POST
- ⊗ FOUND "X" CHISELED ON CONCRETE FOUNDATION
- ⊙ SET 5/8" x 30" REBAR WITH ORANGE PLASTIC CAP MARKED "ALBERT 5203S"



David M. Albert

CERTIFICATE OF COUNTY TREASURER

I, Kim Harris Treasurer of Lewis & Clark County, Montana do hereby certify that the accompanying plat has been duly examined and that no real property taxes assessed and levied on the land to be subdivided are delinquent. (Geo 1888-1944-11-5-0000)

Dated this 17th day of January, 1992.

R.K. Jindan

CERTIFICATE

I, _____ Montana, do hereby certify to office this _____ day of _____ of the Records of the County

Le C County

ROUTE SLIP

Class II Closure #90

DEPARTMENT OF HEALTH & ENVIRONMENTAL SCIENCES

TO:

DATE:

1.

2.

3.

☒ Approval

☒ Comment

☐ Necessary Action

☐ Note and Return

☐ Note and File

☐ Investigate

☐ Prepare reply

☐ Signature

☐ See Me

☐ As requested

☐ For your information

☐ Per Conversation

REMARKS: please file ^{is a} copy in the City of Helena Class II Closure file and one in the Complaint file (give to Carol)

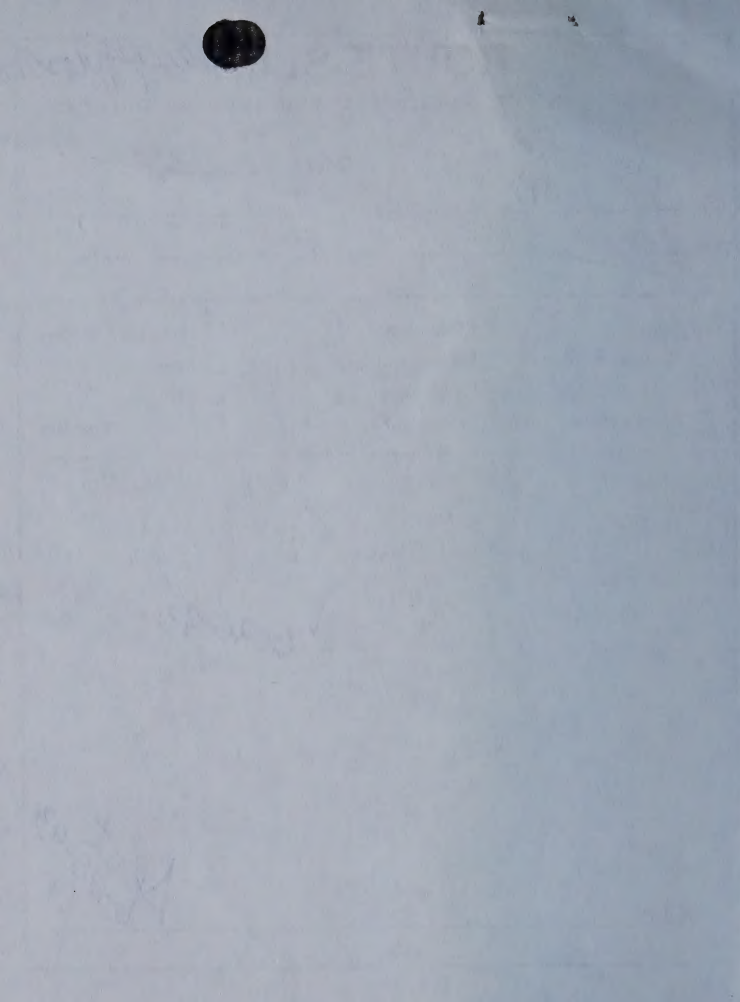
cc: Steve Pilcher ✓ 6-25-93

Thanks!

FROM:

Lara D.

Sent 6-25-93
en



DEPARTMENT OF
HEALTH AND ENVIRONMENTAL SCIENCES
Solid and Hazardous Waste Bureau
Solid Waste Program

MARC RACICOT, GOVERNOR (406) 444-1430

FAX # (406) 444-1499



STATE OF MONTANA

OFFICE 836 Front Street
LOCATION Helena, Montana

MAILING PO BOX 200901
ADDRESS: Helena, MT 59620-0901

TO: Stephanie Wallace, EPA-Helena Office

FROM: Lara M. Dando *lmd*

DATE: June 28, 1993

SUBJECT: Complaint Received From Concerned Citizens About City of Helena Class II Landfill, License #90

I am writing this memorandum in response to the complaint received via letter concerning the City of Helena Class II Landfill. There appeared to have been three major issues that needed to be addressed in the concerned citizens' letter: methane generation; ground water contamination; and the construction of the transfer station on old waste. Let me address each issue separately, based on information submitted by the City of Helena in their landfill closure plan:

Methane Generation - According to the closure plan, the City of Helena Class II Landfill began methane monitoring on a quarterly basis in 1992. The locations of the wells sampled and the results of the sampling events are on-file in this office. The Montana Power Company Office, YMCA Basement, Armory, Elk River Concrete, and the landfill office were also sampled each time. Once the transfer station has been built, it too will be monitored for methane generation. Methane monitoring in the area of the landfill has shown that lateral migration of methane from the landfill to adjacent properties is generally minimal. The Solid Waste Program is currently working with the city to design a more extensive methane monitoring program.

Ground Water Contamination - Ground water monitoring around the landfill has occurred semiannually since January 1992. The location of the wells, parameters tested, and results of sampling events are on-file in this office. Ground water monitoring at the landfill has shown that water downgradient of the landfill contains several organic constituents that are being watched closely. The program is currently working with the city to design a more extensive ground water monitoring program for the landfill.

Transfer Station Construction - This spring, the City of Helena began construction on their licensed transfer station (#320). The building itself, as you know, will not be built on buried waste, but on ground previously used by Elk River Concrete. Only the roads leading to the station would be placed on buried waste, and this area has been designed to protect the integrity of the final cover. Approved transfer Station plans are on-file in our office.

cb5405\wp\closure\helena.co\compltnt.624

STATE OF



TO: Stephen Wilson, Esq.
JAN 21 1962
DATE: JAN 21 1962

SUBJECT: Complaint Received from
Lambert, Eugene W.

I am writing this memorandum in response to the City of Chicago (Case # 1-100000) which is being referred to the Attorney General's Office for review and the recommendation of the Attorney General. The information received from the City of Chicago is as follows:

Attorney General - According to the Chicago Police Department, the following information was received from the Chicago Police Department:

ROUTING AND TRANSMITTAL SLIP

Date

6/17/93

TO: (Name, office symbol, room number,
building, Agency/Post)

Initials

Date

1. John Dilliard

2. SHWR

3.

4.

5.

Action	File	Note and Return
Approval	For Clearance	Per Conversation
As Requested	For Correction	Prepare Reply
Circulate	For Your Information	See Me
Comment	Investigate	Signature
Coordination	Justify	

REMARKS

John - could you please
give me a call about
this? Thanks.

RECEIVED

JUN 21 1993

MONTANA DEPARTMENT OF HEALTH
AND ENVIRONMENTAL SCIENCES
SOLID AND HAZARDOUS WASTE BUREAU

DO NOT use this form as a RECORD of approvals, concurrences, disposals,
clearances, and similar actions

FROM: (Name, org. symbol, Agency/Post)

Room No.—Bldg.

J. Wallace, EPA

Phone No.

5041-102

OPTIONAL FORM 41 (Rev. 7-76)
Prescribed by GSA
FPMR (41 CFR) 101-11.206



RECEIVED

10th 1900

RECEIVED BY THE
TREASURER OF THE
UNITED STATES OF AMERICA

10th 1900

May 7, 1993

*Heath - Please
respond
G. W. W. W.*

*ERC
GM*

To whom it may concern,

The current City of Helena landfill has many buildings on or adjacent to the landfill. A college is located in close proximity and to date no work has been done to consider monitoring or mitigation of explosive landfill gas. We have been told this is a violation of Subtitle D and the RCRA Act as contained in parts 257, 258 and the Clean Air Act (CAA).

Currently the city is building a large transfer station on or practically on the old fill. In addition to the explosive hazards to personnel, there is also liability from asphyxiation, smog, odor, greenhouse, vegetation or groundwater contamination.

With a college, YMCA and workers inside enclosed buildings, it appears as if a serious accident is just waiting to happen.

As I understand it from the regulatory agencies, OSHA and the EPA are the only federal agencies that will consider action. I hope a review will save someone from a serious injury.

My neighbors and I have been told that after October, 1993 we may bring law suits against the owner and operators of the City landfill property under RCRA guidelines (at this time we have not been able to determine the owner). It is until October that we are worried about. Please see if there are safety precautions being considered in the old and new buildings planned (designs, migration and collection devices as well as education of students, etc.).

Very truly yours,

Concerned Citizens

cc: OSHA
EPA
Carroll College
MEIC
YMCA

ENVIRONMENTAL
PROTECTION AGENCY

JUN 2 1993

MONTANA OFFICE

The following is a list of the names of the persons who have been named in the above mentioned cases.

The names of the persons who have been named in the above mentioned cases are as follows: (1) John Doe, (2) Jane Smith, (3) Robert Brown, (4) Mary White, (5) Charles Black, (6) William Green, (7) Thomas Grey, (8) James Hall, (9) Elizabeth King, (10) George Lee, (11) Henry Miller, (12) David Wilson, (13) Richard Young, (14) Benjamin Adams, (15) Samuel Baker, (16) Joseph Clark, (17) Daniel Evans, (18) John Foster, (19) William Gibson, (20) Thomas Harris, (21) James Jackson, (22) Robert King, (23) Mary Lee, (24) Charles Miller, (25) William Moore, (26) Thomas Nelson, (27) James Oliver, (28) Robert Parker, (29) Mary Quinn, (30) Charles Reed, (31) William Scott, (32) Thomas Taylor, (33) James Walker, (34) Robert Young, (35) Mary Zane, (36) Charles Adams, (37) William Baker, (38) Thomas Clark, (39) James Evans, (40) Robert Foster, (41) Mary Gibson, (42) Charles Harris, (43) William Jackson, (44) Thomas King, (45) James Lee, (46) Robert Miller, (47) Mary Moore, (48) Charles Nelson, (49) 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OFFICE OF THE DIRECTOR
ENVIRONMENTAL PROTECTION AGENCY
FEDERAL BUILDING
HELENA MT 59602

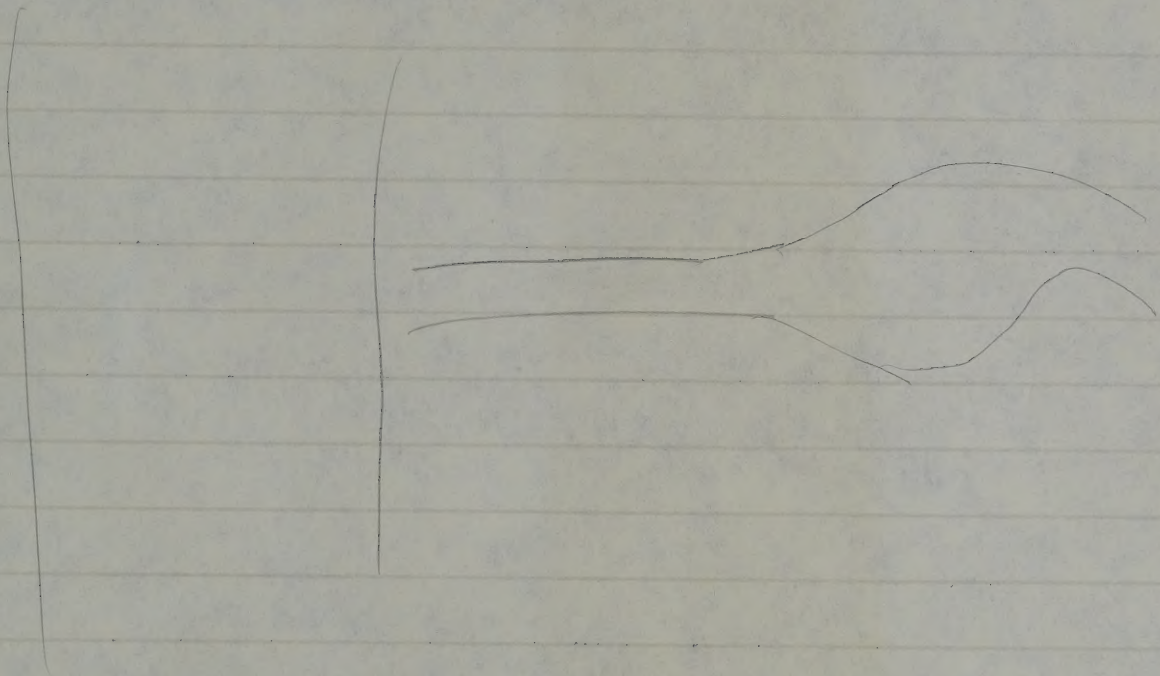


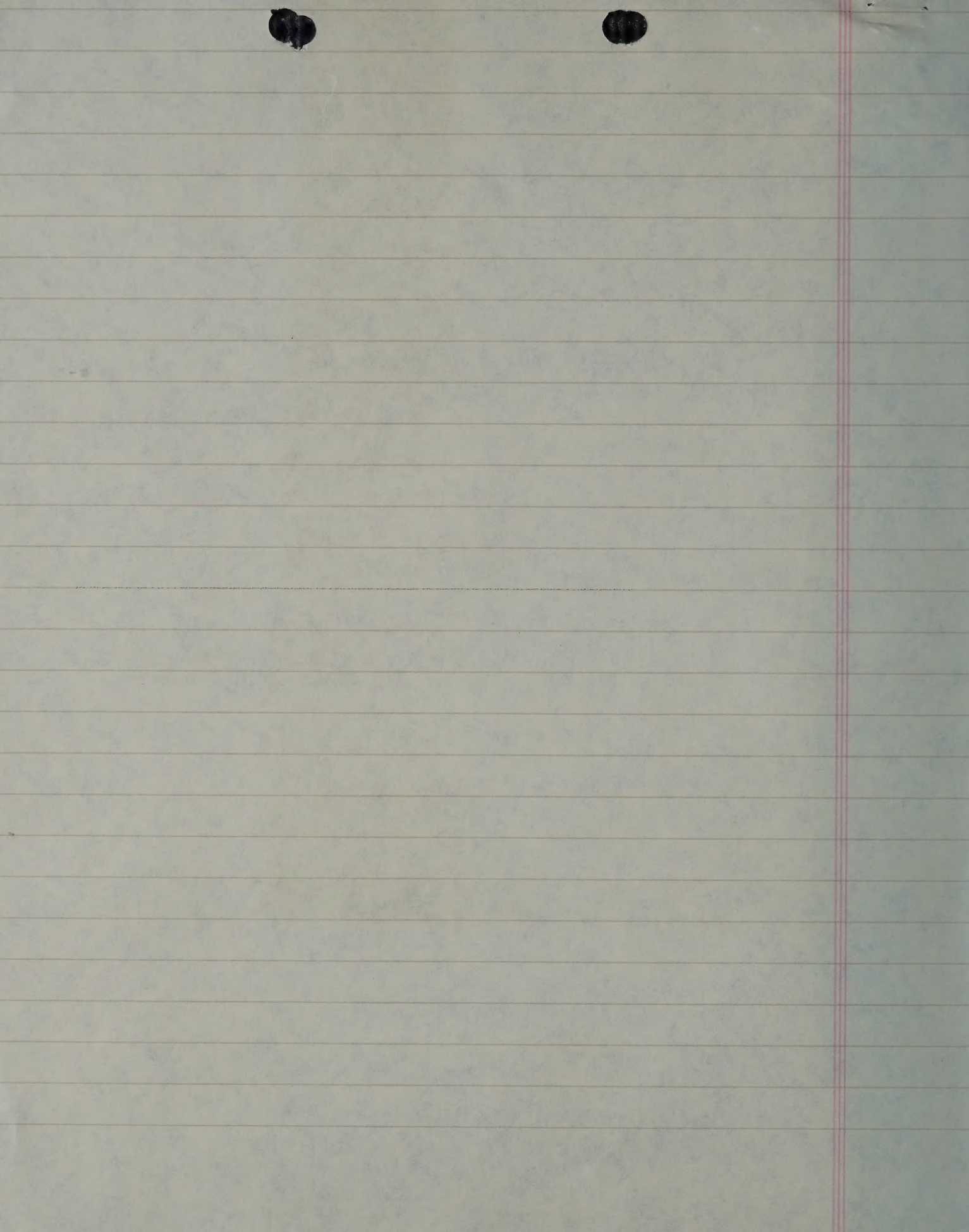
6/1/93

City of Helena Closure Meeting

1:00 pm

Attendance: Jim Wilbur, Lara Dando, & Richard Nesbet





DEPARTMENT OF
HEALTH AND ENVIRONMENTAL SCIENCES
Solid and Hazardous Waste Bureau

Solid Waste Program

MARC RACICOT, GOVERNOR (406) 444-1430

FAX # (406) 444-1499



STATE OF MONTANA

OFFICE LOCATION 836 Front Street
Helena, Montana

MAILING ADDRESS: PO BOX 200901
Helena, MT 59620-0901

May 18, 1993

Richard A. Nisbet
Director of Public Works
City of Helena
City/County Building
316 North Park Avenue
Helena, Montana 59623

SUBJECT: City of Helena Closure

Dear Mr. Nisbet:

On April 30, 1993, James Wilbur, Pat Potts, and I met with Ted Hill, City of Helena, and Mike Wignot and Steven Downs, Hydrometrics, Inc., to discuss certain closure aspects for the City of Helena Class II Landfill. Mr. Downs has already informed you as to what was discussed at that meeting in his May 4, 1993 letter to you. The purpose of this letter is to formally request the following information concerning the landfill's March 1993 revised closure plan:

- (1) Information on the procedures taken for well abandonment for well number 82-4, situated in the center of the landfill.
- (2) A plan map indicating the location of all waste cells, including the area of Centennial Park (if the information is available), in relation to potentiometric contours.
- (3) A copy of the plans for the transfer station's detention pond, for our files.
- (4) A plan map indicating the run-off/run-on diversion ditch situated between the transfer station site and the rest of the closed landfill (it appears to run north-south across the landfill).

Didn't know needed more clarification

A separate plan sheet for each of the items requested above is not required. If you can fit some of the information on the same sheet, that would be acceptable. It is not our intention to hold up the construction of the transfer station or the landfill closure process, but to make sure there is documentation on all aspects of closure in our files.

Concurrently, the Montana Department of Health and Environmental Sciences would like to notify you that the plans for the storm drain channel design have been approved. We would

Capital
and
Bond
Section
RECEIVED

Page 2
May 18, 1993

like the following additional information for our records: (1) a plan map showing the extent of the channel into the neighboring property; (2) a brief discussion on how the new channel design will help prevent potential ground water contamination; and (3) a plan for monitoring potential impacts.

On May 12, 1993, Bill Michalson, City of Helena, and I (with the help of a back-hoe) dug fourteen (14) test pits to verify that at least eighteen (18) inches of compacted clay had been placed over waste in the area of the future transfer station. All but one, at seventeen (17) inches, had more than the minimum required for closure. Mr. Michalson has reassured me that this will be corrected. Therefore, MDHES is satisfied that the waste has been properly covered with the compacted clay and does not foresee any delays in the continued construction of the transfer station or the closure of the landfill. I would like to thank Mr. Michalson for inviting me out to the landfill on such a beautiful day to help with the test pits. Keep up the good work!

If you would prefer to meet and discuss these questions or any other aspect of the closure plan, James Wilbur, Pat Potts, and I would be willing to meet with you. Just give us a week lead time to get everything set up. In the meantime, please do not hesitate to contact this office if you have any questions or comments.

Sincerely,

Lara M. Dando
Environmental Specialist

cc: Ted Hill, City of Helena, 316 North Park Avenue, Helena, MT 59623
Steven Downs, Hydrometrics, Inc., 2727 Airport Road, Helena, MT 59601
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overflow from
Eureka Well
+ storm
water

Page 2
May 12, 1964

like the following additional information for the records: (1) a plan map showing the extent of the channel into the neighboring property; (2) a cross-section on how the new channel design will help prevent potential ground water contamination; and (3) a plan for maintaining potential impacts.

On May 12, 1964, Bill Richardson, City of Houston, and I with the help of a backhoe dug Houston (14) and this to verify that at least eight (8) inches of compacted clay had been placed over waste in the area of the former transfer station. All but one, at seventeen (17) inches, and even then the minimum required for closure. Mr. Richardson has reviewed the plan and will be returned. The plan, which is attached, shows the waste has been properly covered with the compacted clay and does not present any danger in the continued maintenance of the transfer station on the shores of the landfill. I would like to thank Mr. Richardson for inviting me out to the landfill on such a beautiful day to help with the test. Keep up the good work.

It was a great pleasure to meet and discuss these questions at my first report of the channel. Please James Wilbur, Pat Fourn, and I would be willing to meet with you. Just give us a week and we will be ready to go. In the meantime, please do not hesitate to contact this office if you have any questions or comments.

Sincerely,

Larry M. Dando
Environmental Specialist

The City of Houston, 715 Texas Road, Houston, Texas 77002
Phone: (713) 765-1000
Telex: 765100
FAX: 765100

Lewis & Clark
Lic#

ROUTE SLIP

DEPARTMENT OF HEALTH & ENVIRONMENTAL SCIENCES

TO:

DATE:

June 2, 1993

1. *Jim TW*
2. *Jon JD* *pat*
3. *File: Lewis & Clark Co/ City of Helena Class*
II Land Shell Closure file

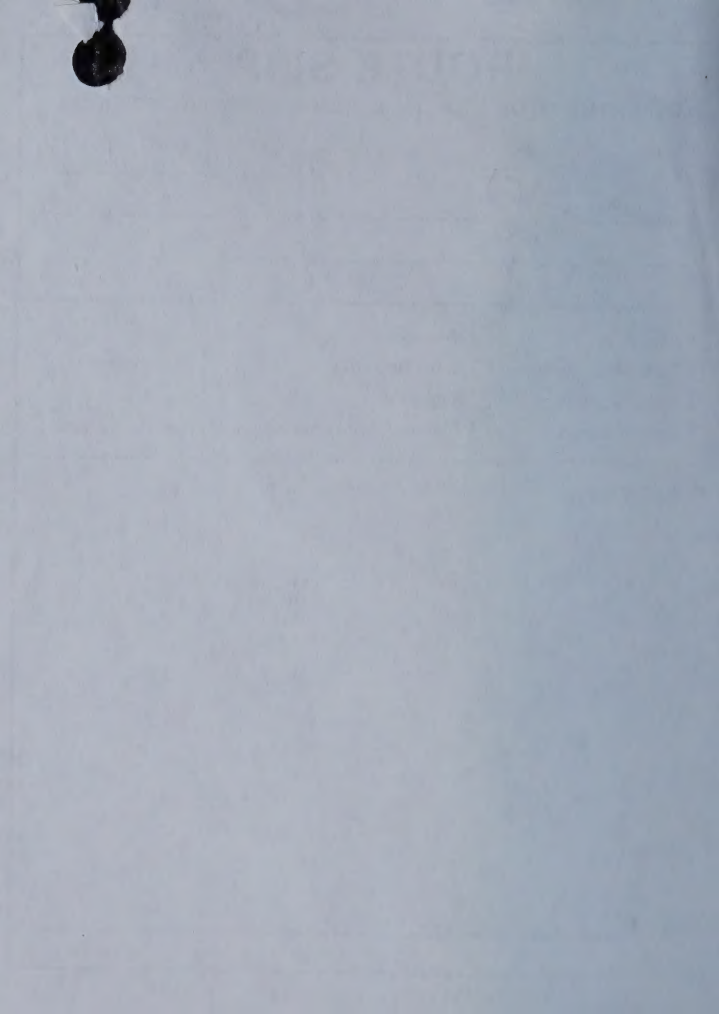
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| ☐ Approval | ☐ Comment | ☐ Necessary Action |
| ☐ Note and Return | ☐ Note and File | ☐ Investigate |
| ☐ Prepare reply | ☐ Signature | ☐ See Me |
| ☐ As requested | ☒ For your information | ☐ Per Conversation |

REMARKS:

Maps & slides attached

FROM:

Lara J.



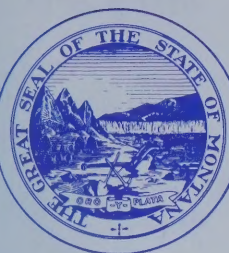
DEPARTMENT OF
HEALTH AND ENVIRONMENTAL SCIENCES

Solid and Hazardous Waste Bureau

Solid Waste Program

MARC RACICOT, GOVERNOR (406) 444-1430

FAX # (406) 444-1499



STATE OF MONTANA

OFFICE 836 Front Street
LOCATION Helena, Montana

MAILING PO BOX 200901
ADDRESS: Helena, MT 59620-0901

TO: City of Helena Class II File, License Number 90

FROM: Lara M. Dando *LMD*

DATE: June 2, 1993

SUBJECT: May 12, 1993 Test of 18" Clay Cover Over Waste, Transfer Station Area

On May 12, 1993, at 1:30 p.m., I met with Bill Michalson, City of Helena, and Chuck, backhoe operator, at the City of Helena Class II Landfill in order to test the adequacy of 18" of compacted clay for an infiltration layer in the vicinity of the future transfer station. We dug a total of 14 pits throughout the area where the transfer station will be built (see attached map). The following is a compilation of my notes on each pit:

TEST PIT 1 -

Location: Dug near future entrance to entire site in future roadway.
Depth: 18" to waste.

TEST PIT 2 -

Location: Dug in future north-south roadway; east side of site;
Depth: 22" to waste (City will cut 4" off to make 18" and to help grade the road).

TEST PIT 3 -

Location: Further west along future roadway to southern entrance to building.
Depth: 21" to about 2' of gravel that was placed on top of daily cover to get it to grade.

TEST PIT 4 -

Location: Further west along future roadway to southern entrance to building.
Depth: 20" to about 2' of gravel that was placed on top of daily cover to get it to grade.

TEST PIT 5 -

Location: Located by southern entrance to transfer station.
Depth: 18-19" to 2' of gravel that was placed on top of daily cover to get it to grade.

4/30/93 Helena, MT
City of Helena Class II
-closure work-



Storm Drain
Extension

4/30/93 City of Helena
Class II Landfill
-closure work-



Infiltration gallery
north of landfill

5/12/93 City of Helena
Class II Landfill
-closure work-



Future site of transfer
station

5/12/93 City of Helena
Class II Landfill
-closure work-



Test pit - checking
18" of compacted clay
cover

5/12/93 City of Helena
Class II Landfill
-closure work-



Testing 18" of compacted
clay cover in transfer
station area.

4/30/93 City of Helena
Class II Landfill
-closure work-



Storm drain extension
Looking south

5/12/93 City of Helena
Class II Landfill
-closure work-



Area of future transfer
station. Stockpiled
cover material.

5/12/93 City of Helena
Class II Landfill
-closure work-



Future site of transfer
station.

5/12/93 City of Helena
Class II Landfill
-closure work-



Testing 18" of compacted
clay cover in transfer
station area.

4/30/93 City of Helena
Class II Landfill
-closure work-



storm drain extension

5/12/93 City of Helena
Class II Landfill
-closure work-



Testing 18" of compacted
clay in transfer
station area.

5/12/93 City of Helena
Class II Landfill
-closure work-



Testing 18" of compacted
clay cover in transfer
station area.

5/12/93 City of Helena
Class II Landfill
-closure work-



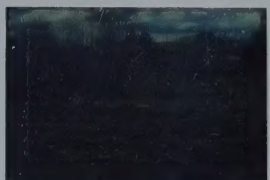
18" of ^{clay} cover on old
waste. Future site of
transfer station

5/12/93 City of Helena
Class II Landfill
-closure work-



Working on water system
SW of landfill.

4/30/93 City of Helena
Class II Landfill
-closure work-



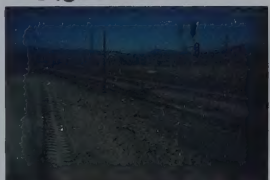
storm drain extension
area

5/12/93 City of Helena
Class II Landfill
-closure work-



Future site of transfer
station.

5/12/93 City of Helena
Class II Landfill
-closure work-



Northside of landfill

5/12/93 City of Helena
Class II Landfill
-closure work-



checking 18" of clay cover
on waste.

City of Helena
Class II Landfill
License #90

5/1/93



LMD



LMD

Looking north



LMD



LMD

Test pit #1



LMD



LMD



LMD



LMD

LMD



LMD



LMD



LMD



LMD



LMD



LMD

City of Helena
Class II
OP4

1/12



LMD

Bill Michelson, City
of Helena in shot.



LMD



LMD

looking north



LMD



LMD



LMD

Test pit #1



LMD



LMD



LMD



LMD



LMD



LMD



LMD



LMD



LMD

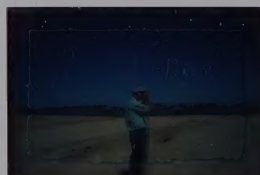


LMD



LMD

Bill Michalson, City of Helena in shot.



LMD



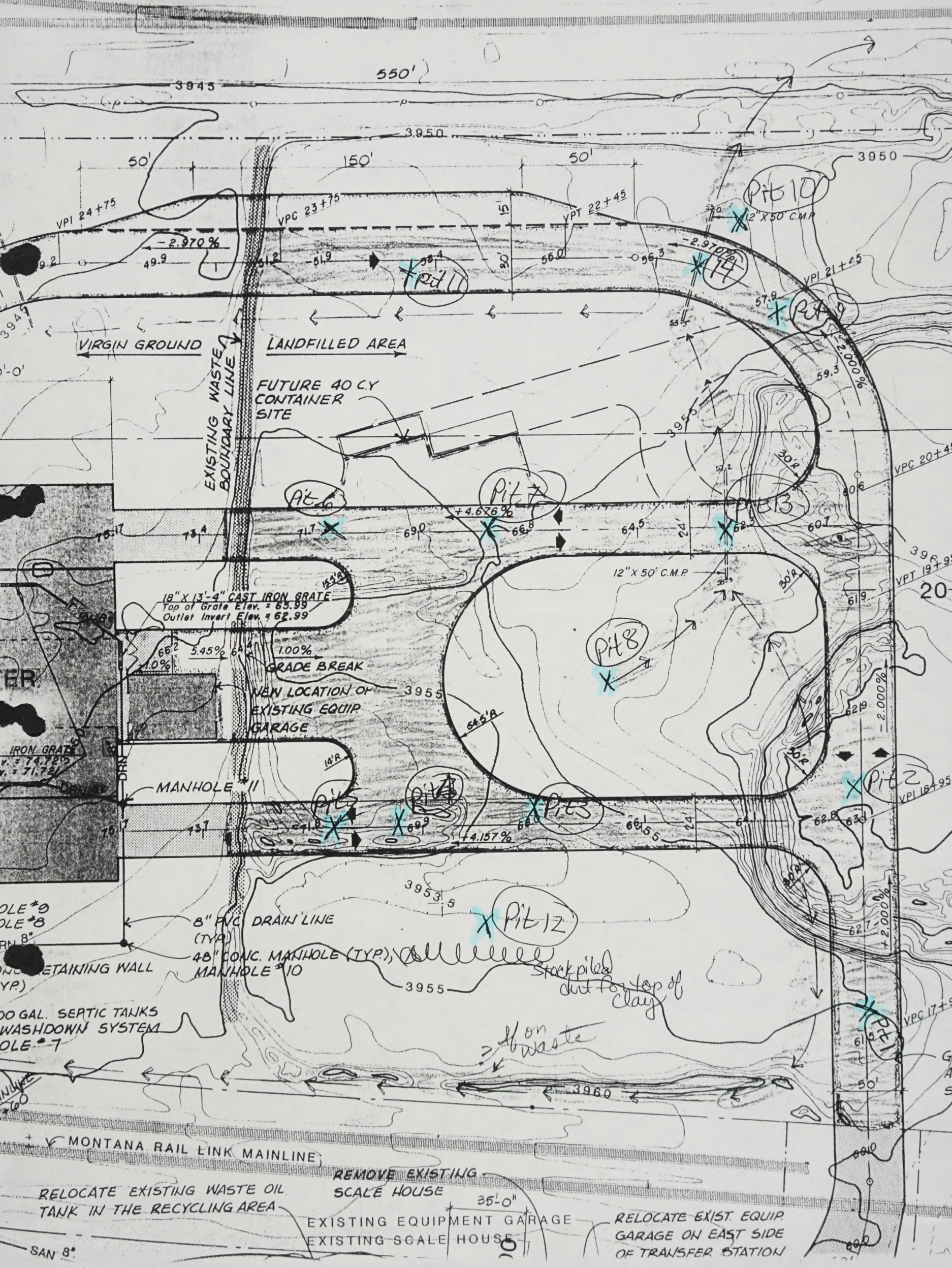
LMD



LMD

City of Helena
Class II
JP# 1000000

1/2



ROUTE SLIP

DEPARTMENT OF HEALTH & ENVIRONMENTAL SCIENCES

TO:

Proofs

DATE:

5/14/93

1.

P³ ✓

4.

Roger pc

2.

Jim IW

5.

Duane DR

3.

Jon ID

- | | | |
|--|---|---|
| ☐ Approval | ☒ Comment | ☐ Necessary Action |
| ☐ Note and Return | ☐ Note and File | ☐ Investigate |
| ☐ Prepare reply | ☐ Signature | ☐ See Me |
| ☐ As requested | ☐ For your information | ☐ Per Conversation |

REMARKS:

Please file in Lewis & Clark Co. /
City of Helena Class II Landfill
and a copy in the City of Helena
Transfer Station file.

Thank you!

FROM:

Lara D.

mailed
5-19-93
LD



DEPARTMENT OF
HEALTH AND ENVIRONMENTAL SCIENCES
Solid and Hazardous Waste Bureau
Solid Waste Program

MARC RACICOT, GOVERNOR (406) 444-1430

FAX # (406) 444-1499



STATE OF MONTANA

OFFICE 836 Front Street
LOCATION Helena, Montana

MAILING PO BOX 200901
ADDRESS: Helena, MT 59620-0901

May 18, 1993

Richard A. Nisbet
Director of Public Works
City of Helena
City/County Building
316 North Park Avenue
Helena, Montana 59623

SUBJECT: City of Helena Closure

Dear Mr. Nisbet:

On April 30, 1993, James Wilbur, Pat Potts, and I met with Ted Hill, City of Helena, and Mike Wignot and Steven Downs, Hydrometrics, Inc., to discuss certain closure aspects for the City of Helena Class II Landfill. Mr. Downs has already informed you as to what was discussed at that meeting in his May 4, 1993 letter to you. The purpose of this letter is to formally request the following information concerning the landfill's March 1993 revised closure plan:

- (1) Information on the procedures taken for well abandonment for well number 82-4, situated in the center of the landfill.
- (2) A plan map indicating the location of all waste cells, including the area of Centennial Park (if the information is available), in relation to potentiometric contours.
- (3) A copy of the plans for the transfer station's detention pond, for our files.
- (4) A plan map indicating the run-off/run-on diversion ditch situated between the transfer station site and the rest of the closed landfill (it appears to run north-south across the landfill).

A separate plan sheet for each of the items requested above is not required. If you can fit some of the information on the same sheet, that would be acceptable. It is not our intention to hold up the construction of the transfer station or the landfill closure process, but to make sure there is documentation on all aspects of closure in our files.

Concurrently, the Montana Department of Health and Environmental Sciences would like to notify you that the plans for the storm drain channel design have been approved. We would



May 12, 1961

Richard A. White
Director of Public Works
City of Boston
City Planning Division
310 State Park Avenue
Boston, Massachusetts 02118

SUBJECT: City of Boston, Boston

Dear Mr. White:

On April 20, 1961, James Wilson, for the City of Boston, advised that the City of Boston is planning to build a new City of Boston Class II building, the Boston City Hall, at the corner of City Hall Square and City Hall Street, Boston, Massachusetts. The estimated cost of the building is \$10,000,000. The building is to be built on a site which is currently zoned for office use. The building is to be built on a site which is currently zoned for office use.

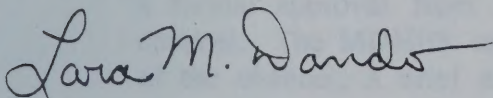
Page 2
May 18, 1993

like the following additional information for our records: (1) a plan map showing the extent of the channel into the neighboring property; (2) a brief discussion on how the new channel design will help prevent potential ground water contamination; and (3) a plan for monitoring potential impacts.

On May 12, 1993, Bill Michalson, City of Helena, and I (with the help of a back-hoe) dug fourteen (14) test pits to verify that at least eighteen (18) inches of compacted clay had been placed over waste in the area of the future transfer station. All but one, at seventeen (17) inches, had more than the minimum required for closure. Mr. Michalson has reassured me that this will be corrected. Therefore, MDHES is satisfied that the waste has been properly covered with the compacted clay and does not foresee any delays in the continued construction of the transfer station or the closure of the landfill. I would like to thank Mr. Michalson for inviting me out to the landfill on such a beautiful day to help with the test pits. Keep up the good work!

If you would prefer to meet and discuss these questions or any other aspect of the closure plan, James Wilbur, Pat Potts, and I would be willing to meet with you. Just give us a week lead time to get everything set up. In the meantime, please do not hesitate to contact this office if you have any questions or comments.

Sincerely,



Lara M. Dando
Environmental Specialist

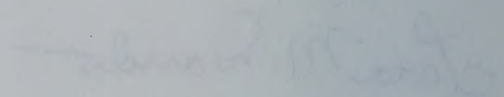
cc: Ted Hill, City of Helena, 316 North Park Avenue, Helena, MT 59623
Steven Downs, Hydrometrics, Inc., 2727 Airport Road, Helena, MT 59601
f:\usr\cb5405\wp\closure\helena.co\drain.513

like the following additional information for our records: (1) a plan map showing the extent of the project into the neighboring property; (2) a brief description of the new drainage design will help prevent potential future water contamination; and (3) a plan for monitoring potential impacts.

On May 12, 1963, Bill Peterson, City of Houston, and I went to the site of a backhoeing project (14) and saw in person that at least eight (8) inches of contaminated soil had been placed over waste in the area of the former industrial site. All but one of the backhoes, however, had more than the minimum required for the site. Mr. Peterson also indicated that this soil be restricted. Therefore, MCHES is required that the waste and such property located with the contaminated soil and does not become any other in the community. The waste material on the ground is the same as the waste that was placed in the waste material on the ground on the landfill on which a beautiful day to begin with the last day. Keep up the good work!

If you would prefer to meet and discuss these questions in any other aspect of the design, please let me know. I would be willing to meet with you. Just give me a call and I will be there. In the meantime, please do not hesitate to contact this office if you have any questions or concerns.

Sincerely,



J. M. Jordan
Environmental Specialist

In the City of Houston, Texas, this 18th day of May, 1963, I, J. M. Jordan, do hereby certify that the foregoing is a true and correct copy of the original as the same appears in my files.

Hydrometrics, Inc.



2727 Airport Road • Helena, Montana 59601 • (406) 443-4150 • FAX (406) 443-4155

May 4, 1992

Mr. Richard A. Nisbet
Director of Public Works
City of Helena
City/County Building
316 North Park
Helena, MT 59623

RECEIVED
MAY 05 1993
MONTANA DEPARTMENT OF HEALTH
AND ENVIRONMENTAL SCIENCES
SOLID AND HAZARDOUS WASTE

Dear Dick,

The purpose of this letter is to summarize our April 30, 1993 meeting with the Montana Department of Health and Environmental Sciences (MDHES). Attending this meeting were Ted Hill from the City, Mike Wignot and Steve Downs from Hydrometrics, Inc., and Lara Dando, Jim Wilbur, and Pat Potts from MDHES.

The primary objective of the meeting was to discuss the storm drain channel extension, and determine what additional information the MDHES would need in order to obtain a formal approval from them so that the City could finish the construction on the channel. The MDHES replied that they would like a plan map showing the alignment of the channel, a brief description of the potential impacts to groundwater that the channel extension may have, and a suggested plan for monitoring these potential impacts. The MDHES indicated that they had no problems with the channel design itself. Ted Hill indicated that the City engineering department may already have a plan map showing the channel alignment which could be submitted to the MDHES.

The MDHES also discussed several other aspects of the recently submitted "Revised Helena Landfill Closure Plan." The MDHES stated that they were pleased with the Plan's methane monitoring plan, although they would like some of the monitoring sites on Figure 6-1 clarified. The MDHES also mentioned that they would like us to consider adding the City Pool building to the monitoring schedule. They also would like us to provide them with a typical methane monitoring probe diagram.

The MDHES also mentioned that the use of the clayey soils from Site E as the erosion/topsoil layer was acceptable, however the top six inches should not be compacted to help improve its suitability for vegetation. It was also mentioned that if vegetation could not be established on this soil, then the soil may have to be amended, or additional topsoil may be needed.

May 4, 1992

Mr. Richard A. Weber
Director of Public Works
City of Helena
City County Building
316 North Park
Helena, MT 59601

Dear Dick:

The purpose of this letter is to summarize our April 30, 1992 meeting with the Montana Department of Health and Environmental Science (MDES). Attending this meeting were Ted Hill from the City, Mike Weber and Steve Flowers from Hydrometals, Inc., and Lane Dando, Jim Weber, and Pat Fouts from MDES.

The primary objective of the meeting was to discuss the storm drain channel extension and determine what additional information the MDES would need in order to obtain a formal approval from them so that the City could finish the construction on the channel. The MDES replied that they would like a plan area showing the alignment of the channel, a brief description of the potential impacts to groundwater that the channel extension may have, and a suggested plan for monitoring these potential impacts. The MDES indicated that they had no problem with the channel design itself. Ted Hill indicated that the City engineering department may already have a plan map showing the channel alignment which could be submitted to the MDES.

The MDES also discussed a level other than 2 feet of the recently submitted "Revised Helena Landfill Closure Plan". The MDES stated that they were pleased with the Plan's methane monitoring plan, although they would like some of the monitoring sites on Pages 6-1 clarified. The MDES also mentioned that they would like us to consider adding the City Pool building to the monitoring schedule. They also would like us to provide them with a typical methane monitoring probe diagram.

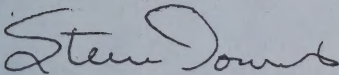
The MDES also mentioned that the use of the clayey soils from Site B as the capping material layer was acceptable, however the top six inches should not be compacted to help improve its suitability for vegetation. It was also mentioned that if vegetation could not be established on this soil then the soil may have to be amended, or additional topsoil may be needed.

Mr. Richard A. Nisbet
May 4, 1993
Page 2

Pat Potts also mentioned that the MDHES will soon be addressing the Maximum Contaminant Limit exceedances that have been observed in samples from monitoring wells near the landfill. This may require significant additional work by the City to better define groundwater impacts in the area. A meeting to discuss these groundwater issues has been tentatively scheduled for 3:00 P.M., May 6, 1993, so that the City can have an idea of what may be necessary for them to address in their next fiscal year. It was suggested that this meeting include Vivian Drake from the City/County water quality protection district. Potential alternatives for monitoring the storm channel extension affect to groundwater will also be discussed at this meeting.

It is my understanding that Ted Hill is planning to attend the May 6 meeting, and it may be prudent for you to attend also to make sure that the MDHES is aware of the City's perspective on these issues. Please let me know if this time is convenient for you. Please call if you have any questions.

Sincerely,



Steven K. Downs
Senior Engineer

Copy: Lara Dando, MDHES
 Ted Hill, City of Helena
 Vivian Drake, Lewis and Clark County

Mr. Richard A. M. Del
May 4, 1993
Page 2

For Potts also mentioned that the MCHES will need to address the Maximum
Contaminant Level Exceedance that have been observed in samples from monitoring
wells near the landfill. This may require significant additional work by the City to better
define groundwater exposure in the area. A meeting to discuss these groundwater issues
has been tentatively scheduled for 2:00 P.M., May 6, 1993, so that the City can have an
idea of what may be necessary for them to address in their next fiscal year. It was
suggested that the meeting include Wayne Dicks from the City's water quality
protection center. Forwarding information for monitoring the site's chemical retention
effect to groundwater will also be discussed at this meeting.

It is my understanding that Ted Hill is planning to attend the May 6 meeting, and it may
be prudent for you to attend also to make sure that the MCHES is aware of the City's
perspective on these issues. Please let me know if this time is convenient for you.
Please call if you have any questions.

Sincerely,


Steven K. Powers
Senior Engineer

Copy:
Lara Dando, MCHES
Ted Hill, City of Helena
Wayne Dicks, Land and Water Center

Lewis & Clark Co. / ^{City of Helena} ~~Class~~ ^{Landfill}

ROUTE SLIP

DEPARTMENT OF HEALTH & ENVIRONMENTAL SCIENCES

TO: Proof LH
P3 ✓ legend needed on X-sec?

DATE: 1/4/93

1. Jim W. JW 4 Roger T. ^{PC}
2. Jon D. JD 5. Duane R. ^{PC}
3. Jon D. JD

- | | | |
|--|---|---|
| ☒ Approval | ☒ Comment | ☐ Necessary Action |
| ☐ Note and Return | ☐ Note and File | ☐ Investigate |
| ☐ Prepare reply | ☐ Signature | ☐ See Me |
| ☐ As requested | ☐ For your information | ☐ Per Conversation |

REMARKS:

Return attached map to Pat ~~Boh~~ ✓

FROM: Lara D.

mailed
1-6-93
er



DEPARTMENT OF
HEALTH AND ENVIRONMENTAL SCIENCES
Solid and Hazardous Waste Bureau

Solid Waste Program

(406) 444-1430

STAN STEPHENS, GOVERNOR

FAX #(406) 444-1499



STATE OF MONTANA

OFFICE 836 Front Street
LOCATION: Helena, Montana

MAILING Cogswell Building
ADDRESS: Helena, MT 59620

January 6, 1993

Steven K. Downs
Hydrometrics, Inc.
2727 Airport Road
Helena, Montana 59601

SUBJECT: City of Helena Class II Landfill Drainage Channel Design

Dear Mr. Downs:

I am writing to you in response to your December 22, 1992 letter to James Wilbur of this office, concerning the City of Helena Class II Landfill drainage channel design. Thank you for submitting this information to us. Upon review several questions arose concerning the drainage design illustrated in Figure 1. First, please explain where exactly this lined drainage channel will be constructed in relation to plan sheet #3, Closure Plan - Final Grading and Drainage, *Helena Landfill Closure Plan*. Similarly, will runoff flow into the existing storm drain inlets located on the north and south sides of the landfill? Third, in order to fully understand the lined drainage channel, please include a legend explaining the various features indicated on Figure 1 (submitted 12/22/92). And finally, where would the buried waste be located in relationship to the lined drainage channel?

If you would prefer to meet and discuss these questions or any other aspect of the closure plan, James Wilbur, Pat Potts, and I would be willing to meet with you. Just give us a week lead time to get everything set up. In the mean time, please do not hesitate to contact this office if you have any questions or comments.

Sincerely,

A handwritten signature in cursive script that reads "Lara M. Dando".

Lara M. Dando
Environmental Specialist

cc: City of Helena, 316 N. Park Ave., Helena, MT 59623
larad\wp\closure\helnadm.jal



January 4, 1907

James K. Downey
Hydroelectric, Inc.
227 Adams Street
Helena, Montana 59601

SUBJECT: City of Helena Class II Landfill Disposal

Dear Mr. Downey:

I am writing to you in response to your letter of January 2, 1907, regarding the City of Helena Class II Landfill Disposal. The design shown in Figure 1, which shows the landfill to be constructed in relation to plan, is acceptable. The design shows the landfill to be constructed on the north and south sides of the river. The design also shows the landfill to be constructed on the east and west sides of the river. The design is acceptable.



December 22, 1992

Mr. James Wilbur
MT Dept. Health and Env. Sciences
Solid Waste Program
Cogswell Building
Helena, Montana 59620

RECEIVED

DEC 23 1992

MONTANA DEPARTMENT OF HEALTH
AND ENVIRONMENTAL SCIENCES
SOLID AND HAZARDOUS WASTE BUREAU

RE: Helena Landfill Drainage Channel Design

Dear Jim:

City of Helena personnel and I have recently discussed details of the design for the Helena Landfill drainage channel extension with two liner and geotextile distributors. Through these discussions we have developed the final drainage channel design which is described below. Because there are some changes in the design from the one which the MDHES approved in 1991, we thought it prudent to have you review this plan before construction commences.

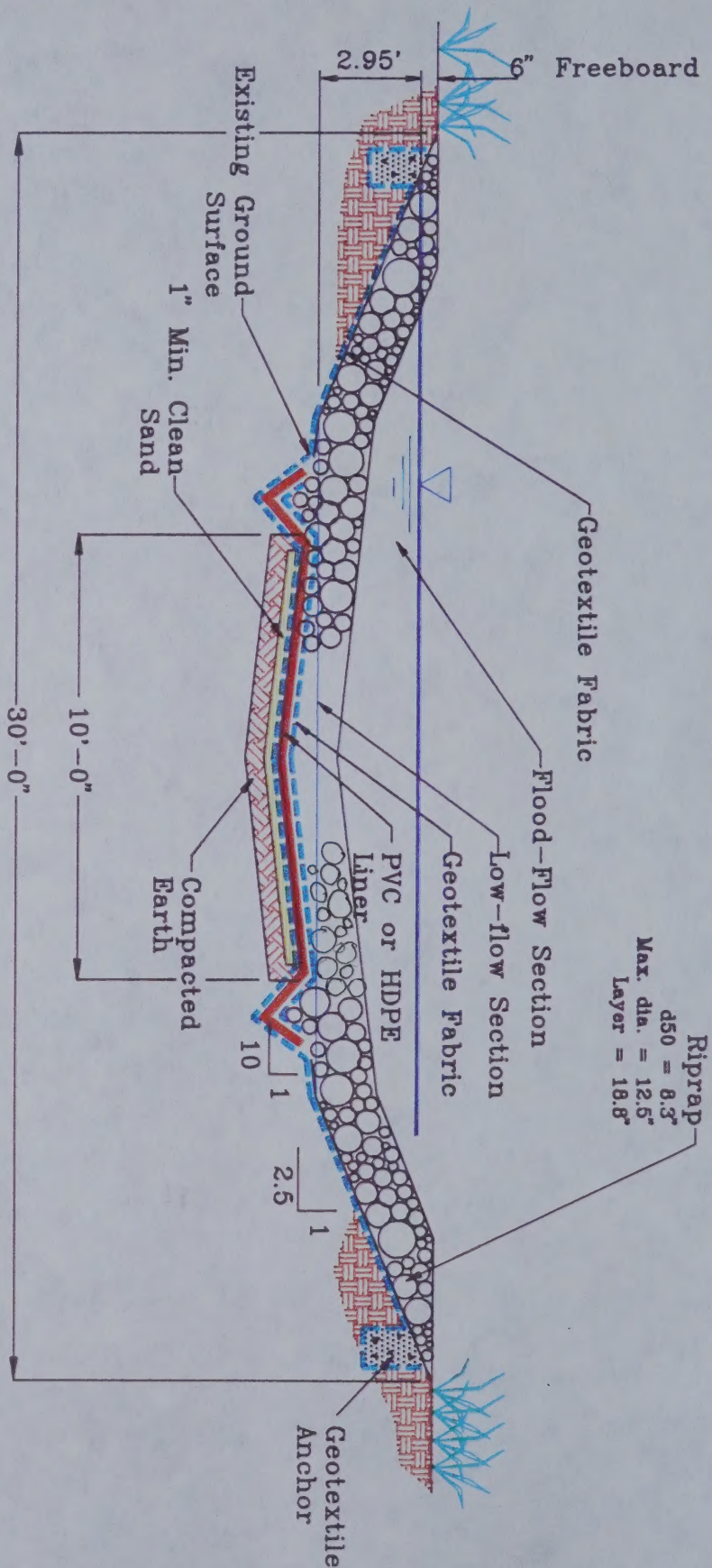
The final drainage channel design is similar to the conceptual design presented in the Helena Landfill Closure Plan with added geotextile cushion to provide more protection to the liner. This design would consist of a ten foot PVC-lined (20 mil PVC) middle section. The PVC would be sandwiched with a geotextile fabric (unwoven 8 oz. fabric AMOCO 4553 or equivalent) for protection. In addition, the same geotextile fabric would be used to stabilize the side slopes. The entire ditch bottom and side slopes would then be riprapped with approximately 18 inches of riprap with a median size of 8 inches. A thin layer (1-2 inches) of sand or small gravel on top of the fabric within the 10 foot liner section (under the riprap) will provide additional protection to the liner especially during installation. Figure 1 is a cross-sectional detail of the final channel design.

All other design aspects are the same as in the "Helena Landfill Closure Plan" conceptual design which was approved by the MDHES in 1991. These final design criteria will be included in the revised "Helena Landfill Closure Plan" which will be submitted to you in early 1993. The City of Helena would like to complete the construction of this channel as soon as possible, and would like the MDHES to review this final design so that construction may commence.

Thank you for your cooperation on this project. If you have any questions, please call anytime.

Sincerely,

Steven K. Downs
Geological Engineer



Not To Scale

HLF2692D

Figure 1.
Storm Sewer Extension Cross-Section
Option 1

Lewis & Clark

ROUTE SLIP ^{Days 11} Closure

DEPARTMENT OF HEALTH & ENVIRONMENTAL SCIENCES

TO:

DATE: 8/3/92

1. Jim JV
2. Jon & Duane Mr
3. Roger S. City of Helena Landfill File

- | | | |
|--|--|---|
| ☐ Approval | ☐ Comment | ☐ Necessary Action |
| ☐ Note and Return | ☐ Note and File | ☐ Investigate |
| ☐ Prepare reply | ☐ Signature | ☐ See Me |
| ☐ As requested | ☒ For your information | ☐ Per Conversation |

REMARKS:

FROM:

Lara D.

mailed
8-5-92
LH



TO: City of Helena Class II Landfill Closure File

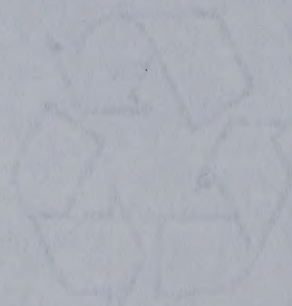
FROM: Lara Dando *LD*

DATE: August 3, 1992

SUBJECT: July 29, 1992 Meeting with Hydrometrics and the City of Helena

On July 29, 1992, at 1:30 P.M. Jim Wilbur, Willie Miller (City of Helena), Steve Downs (Hydrometrics), Mike Wignot (Hydrometrics), and myself met here in the Solid and Hazardous Waste Bureau's Lewis Conference Room. The purpose of this meeting was to discuss closure aspects for the City of Helena Class II Landfill. The following is a brief synopsis of the meeting.

- 1) The City of Helena will reopen the landfill for future use. A plan for this new operation will be submitted. The new lift will be four feet high.
- 2) Hydrometrics informed us that they are in the process of "revamping" the Closure Plan:
 - a. Hydrogeology of the Helena Landfill Area - updated;
 - b. Cover Soil - revised to meet 40 CFR Part 258;
 - c. Final Cover Design - final contour map will have to be redone;
 - d. Closure Certification - O.K. as is; and
 - e. Post-Closure Maintenance and Monitoring - groundwater and methane monitoring will have some changes in it.
- 3) Hydrometrics now know that they have 90 days to submit a copy of the groundwater monitoring sampling report to our office. Historically, they have waited until the annual report was completed to submit this information to the Solid Waste Program.
- 4) We discussed soil permeability tests and how much soil required for final cover, especially in relation to future revegetated areas.
- 5) Willie informed us that the landfill takes asbestos. However, they will phase it out due to the large amount of space required.
- 6) Post-Closure Care - It was discussed that in order for the Solid Waste Program to approve the final Closure Plan:
 - a. The City must continue to report monitoring and inspections of the Centennial Park sprinkler system.
 - b. The revamped closure plan has to include the Centennial Park area as well. There should be a map of this area illustrating where waste had been buried.
 - c. Probes would be acceptable for sampling for methane. Sampling should focus on the populated sides of the landfill especially. Suggested looking up California's sampling methodology.
 - d. Quarterly methane monitoring sampling at minimum required.
 - e. Groundwater monitoring wells could be used for methane monitoring **only** as a back up for the probes.



Cross Points Bond
COTTON AND RECYCLED

f. A question was raised over the fate of EPA and DHES wells once used for monitoring by the City of Helena. The City and Hydrometrics felt they were not responsible for these wells.

7) We did not come to any conclusion as to whether or not the field filtration system should be used for groundwater monitoring or not. Something the Program will have to discuss.

larad\wp\closure\helena.731

A. The following was taken from the report of the City of Portland, Oregon, dated 10/1/77, regarding the City of Portland's (COP) response to the request for information.

B. The following was taken from the report of the City of Portland, Oregon, dated 10/1/77, regarding the City of Portland's (COP) response to the request for information.

Continued on Page 3

City of Portland, Oregon
10/1/77

Closure Plan City of Helena landfill - July 29, 1992

<u>NAME</u>	<u>Representing</u>	<u>Phone #</u>
Jim Wilbur	DHES/SHW	444-1430
Willie Miller	City of Helena	447-8459
Steve Downs	Hydrometrics	443-4150
Mike Wignot	"	"
Lara M. Dando	DHES/SHW	444-1430

ROUTE SLIP

DEPARTMENT OF HEALTH & ENVIRONMENTAL SCIENCES

TO:

PROOF LL

DATE:

11/21/91

1.

Jon D. JD

2.

Patti P. PP

3.

Roger T. RCT

Duane R. DR

- | | | |
|--|--|---|
| ☒ Approval | ☒ Comment | ☐ Necessary Action |
| ☐ Note and Return | ☐ Note and File | ☐ Investigate |
| ☐ Prepare reply | ☒ Signature | ☐ See Me |
| ☐ As requested | ☒ For your information | ☐ Per Conversation |

REMARKS:

Sent 11/26/91

FROM:

Ralph Smith



THE END

1/1/11

1/1/11

1/1/11

DEPARTMENT OF
HEALTH AND ENVIRONMENTAL SCIENCES

City of
Helena
Lic Co.
Lic #90



STAN STEPHENS, GOVERNOR

FAX #(406) 444-1499

STATE OF MONTANA

OFFICE 836 Front Street
LOCATION: Helena, Montana

MAILING Cogswell Building
ADDRESS: Helena, MT 59620

Solid & Hazardous Waste Bureau
Telephone: (406) 444-1430

November 21, 1991

City of Helena
Dick Nisbet, Director of Public Works
City/County Building
316 North Park Avenue
Helena, MT 59623

Dear Mr. Nisbet:

The purpose of this letter is to acknowledge receipt of the "Helena Landfill Closure Plan" from the City's consultant, Hydrometrics, Inc. The proposed work plan overall is very good, however, there will be additional requirements necessary for proper closure of the City of Helena landfill (License # 90) before the Montana Department of Health and Environmental Sciences (MDHES) will approve the landfill closure plan.

1. It appears that minimum State soil cover permeability requirements will be met in the proposed plan for the City of Helena landfill closure. Federal standards for landfill closure final cover requirements promulgated in EPA Subtitle D Regulations will be required for waste disposal cells which receive wastes after October 9, 1991 and before October 9, 1993. The Federal regulations for final cover requirements are self-implementing. Federal requirements state that the final cover must be designed to minimize infiltration and erosion. The infiltration layer must be a minimum of 18 inches of earthen material that has a permeability less than or equal to the permeability of the natural subsoils, or no greater than 1×10^{-5} cm/sec, whichever is less. The erosion layer must be a minimum of six inches of earthen material that can sustain native plant growth.

2. MDHES strongly recommends that dedicated gas monitoring wells or probes be installed at the City of Helena landfill in order to monitor methane and other gases which have the potential to impact public health and the environment. It is also recommended that a methane venting system be considered. The objective of gas monitoring wells and a methane migration control system is to control the off-site migration of methane and to monitor the methane concentrations in the subsurface at the landfill property line. The main justification for these controls is due to the fact that the landfill is located in an urban area and because there exists a potential for further urban development near the site



THE UNIVERSITY OF CHICAGO
DIVISION OF THE PHYSICAL SCIENCES
DEPARTMENT OF PHYSICS
CHICAGO, ILLINOIS 60637
U.S.A.

TO THE EDITOR OF THE JOURNAL OF THE
ROYAL SOCIETY OF MEDICINE
LONDON

SIR,
I have the honor to acknowledge the receipt of your letter of the 10th inst. in relation to the above-mentioned matter.

I am sorry to hear that you are unable to attend the meeting of the Society on the 15th inst. but I am sure that your absence will be regretted.

I am, Sir, very respectfully,
Yours faithfully,
J. H. B. [Signature]

Enclosed for you are the minutes of the meeting of the Society on the 10th inst. and the report of the Committee on the subject of the proposed amendment to the Rules of the Society.

I am, Sir, very respectfully,
Yours faithfully,
J. H. B. [Signature]

I am, Sir, very respectfully,
Yours faithfully,
J. H. B. [Signature]

itself. This is a public safety issue concern. An additional reason for the implementation of dedicated gas monitoring wells or probes is to ensure that the landfill gases are monitored effectively. It is unlikely that groundwater monitoring wells are designed to effectively monitor landfill gases at the City of Helena Class II Landfill.

A well-designed and well-operated landfill gas collection or venting system would, at a minimum: (1) be capable of handling the maximum gas generation rate, (2) have a design capable of monitoring and adjusting the operation of the system, (3) be able to collect gas effectively from all areas of the landfill that warrant control, and (4) be able to expand by the addition of further collection system components to collect gas from areas of the landfill as they require control. The methane monitoring plan presented in Section 6.3 of the landfill closure plan should be revised. The objective of a methane monitoring system is to control the off-site migration of methane and to monitor the methane concentrations in the subsurface at the landfill property line. Federal EPA Subtitle D regulations will require that methane concentrations not exceed the lower explosive limit (LEL) at the property boundary or exceed 25 percent of the LEL in on-site structures. Lower explosive limit (LEL) means the lowest percent by volume of a mixture of explosive gases in air that will propagate a flame at 25° C and atmospheric pressure. The methane monitoring plan should be revised utilizing federal regulations as a guideline, because the State Administrative Rules do not have methane monitoring criteria at this time.

The proposed semiannual monitoring frequency for methane appears to be less than the anticipated federal criteria of a quarterly monitoring frequency. However, the frequency of the monitoring events should be determined by on-site conditions and should be conducted quarterly at a minimum. Monitoring should be conducted more frequently during periods when the ground is frozen, as this can restrict vertical migration of the gases and cause increased lateral migration.

3. It has been observed that several groundwater monitoring wells at the City of Helena landfill have had insufficient caps and/or locks on them in the past. The groundwater monitoring well system at the City of Helena landfill could be compromised by a security breach to the system, potentially making groundwater sampling results inconclusive. There should be a complete inspection of all groundwater monitoring wells to ensure proper security measures are taken.

4. The City of Helena landfill groundwater monitoring plan is adequate at this time. Long term groundwater monitoring will be

It is a well-known fact that the City of New York is one of the most densely populated cities in the world. The City's population is approximately 8 million, and its area is approximately 300 square miles. The City's population is distributed throughout the City, with the highest concentrations in the five boroughs of Manhattan, Bronx, Queens, Richmond, and Kings. The City's population is also distributed throughout the City's various industries, with the highest concentrations in the financial, retail, and service industries. The City's population is also distributed throughout the City's various ethnic groups, with the highest concentrations in the Italian, Irish, and Jewish ethnic groups.

A well-designed and well-operated landfill is a critical component of the City's waste management system. The landfill is a facility where solid waste is disposed of, and it is a key element in the City's efforts to reduce the amount of waste that is sent to landfills. The landfill is a complex system that involves the collection, transportation, and disposal of waste. The landfill is also a source of revenue for the City, as it charges fees for the disposal of waste. The landfill is a critical component of the City's waste management system, and it is a key element in the City's efforts to reduce the amount of waste that is sent to landfills.

The City's landfill is a complex system that involves the collection, transportation, and disposal of waste. The landfill is a key element in the City's waste management system, and it is a critical component of the City's efforts to reduce the amount of waste that is sent to landfills. The landfill is a source of revenue for the City, as it charges fees for the disposal of waste. The landfill is a complex system that involves the collection, transportation, and disposal of waste. The landfill is a key element in the City's waste management system, and it is a critical component of the City's efforts to reduce the amount of waste that is sent to landfills.

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November 21, 1991

necessary for the City of Helena landfill to assess the safety of public health and the environment.

5. The City of Helena Centennial Park irrigation system appears to not have been inspected since 1989, according to Appendix 4 of the "Soil Moisture Monitoring Plan Results, Centennial Park Report" received at this office on February 5, 1991. Have inspections been conducted? If inspections were done, please submit copies of documents which verify results of these inspections. It is requested that a updated report on the irrigation system at Centennial Park for the past two years (1990 and 1991) be submitted to this office as soon as possible.

6. Please submit a detailed map which delineates the extent of waste disposal areas in Centennial Park and the areas landfilled adjacent to Carroll College property. Where are the waste disposal limits adjacent to the YMCA? This is necessary to assess the entire City of Helena landfill closure with respect to all phases of its site life. Please show all these phases of the City of Helena landfill on one map.

7. Centennial Park has small depressions on the final cover in which ponding of precipitation and surface runoff has occurred. Positive drainage must be maintained, so this problem needs to be corrected. Please submit a corrective action plan to resolve this problem.

8. The proposed final cover design for runoff/runoff surface drainage control is approved, but the positive drainage concerns with Centennial Park will likely require a modification to the proposed final cover design plan.

9. The plan for extension of the City Storm Drain is approved.

10. It was observed on the City of Helena Transfer Station license application that there were drawings of trees located in areas which had received household wastes. Trees are likely to affect the integrity of the landfill cover, and potential leachate production could increase. Trees or other types of vegetation and/or design features which may compromise the integrity of the landfill cover are not recommended.

11. Post-closure care requirements need to be addressed in the City of Helena landfill closure plan more thoroughly. Following closure of each landfill unit the operator must conduct post-closure care. Post-closure care must be conducted to maintain the integrity and effectiveness of any final cover, including making repairs to the cover (as necessary) to correct the effects of settlement, subsidence, erosion, or other events. The frequency of inspection and corrective maintenance activities for the landfill

Page Four

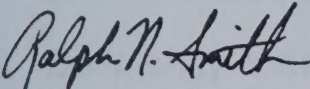
City of Helena Landfill Closure Plan Letter

November 21, 1991

final cover should be stated explicitly in the landfill closure plan.

These are the concerns at this time with the City of Helena Landfill (License # 90) Closure Plan. Additional information will be necessary in order to obtain landfill final closure plan approval. Please respond to the concerns and questions I have outlined above. Enclosed is a copy of the "Landfill Closure Review Sequence" which outlines the closure review process. If you have questions or comments, please contact me at your convenience.

Sincerely,



Ralph N. Smith
Solid Waste Program

Enclosure: "Landfill Closure Review Sequence"

cc: Hydrometrics, Inc., ATTN: Randy Huffsmith, 2727 Airport Road,
Helena, MT 59601

Will Selser, City-County Health Dept., City-County Health
Dept., 316 N. Park, P.O. Box 1723, Helena, MT 59624

Burlington Northern Railroad, 139 N. Last Chance Gulch,
Helena, MT 59601

RNS/rns

LANDFILL CLOSURE REVIEW SEQUENCE

- A Pre-closure discussions with licensee
- B Landfill Closure Plan received
- C Landfill Closure Plan review by DHES
- D Approval (or Disapproval) of Landfill Closure Plan Letter sent by DHES
- E DHES notified Landfill is in "interim closure"
- F DHES conducts Landfill Closure Inspection
- G Deficiency letter (DL) letter sent to licensee
- H Licensee responds to Deficiency letter (DL)
- I DHES conducts Landfill Closure Inspection
- J Landfill Closure Approval Letter sent by DHES to licensee
- K Licensee surrenders Solid Waste Management license to DHES
- L Landfill in final closure
- M Landfill put in "Final Closure" Files

LANDFILL CLOSURE REVIEW RESPONSE

- A. Pre-closure discussions with licensee
- B. Landfill Closure Plan received
- C. Landfill Closure Plan review by DHEC
- D. Approval for Disposal of Landfill Closure Plan Letter sent by DHEC
- E. DHEC notifies landfill is in interim closure
- F. DHEC conducts Landfill Closure Inspection
- G. Deficiency letter (DL) letter sent to licensee
- H. Licensee responds to Deficiency letter (DL)
- I. DHEC conducts Landfill Closure Inspection
- J. Landfill Closure Approval Letter sent by DHEC to licensee
- K. Licensee surrenders Solid Waste Management license to DHEC
- L. Landfill in final closure
- M. Landfill put in "Final Closure" files

City of Helena Landfill Meeting 2/5/91
 at Dept. of Health & Environmental Sciences,
 Solid & Hazardous Waste Bureau,
 Solid Waste Program

<u>NAME</u>	<u>EMPLOYER</u>	<u>PR. #</u>
Ralph N. Smith	DHES-SHWB	444-1430
Tony Grover	" "	" "
Will Secker	LtC County Health	447-8354
Roger Thorvilson	DHES-SHWB	444-1430
Kate McIvor	LtC City/County Health	447-8362
Duane Robertson	DHES-SHWB	444-1430
R. M. ...	City of Helena	447-2455
RANDY HUFF Smith	Hydrometrics	443-4150
M. K. Bora	" "	" "
Bill Verwolf	City of Helena	447-8000
Richard Nisbet	" " "	447-8426
Jim Wilber	DHES-SHWB	444-1430

City of Helena Landfill Meeting 2/5/91
 at Dept. of Health & Environmental Sciences,
 Solid & Hazardous Waste Bureau,
 Solid Waste Program

<u>NAME</u>	<u>EMPLOYER</u>	<u>PR. #</u>
Ralph N. Smith	DHES-SHWB	444-1430
Tony Grouver	" "	" "
Will Selzer	LtC County Health	447-8354
Roger Thorvilson	DHES-SHWB	444-1430
Kate McIvor	LtC City/County Health	447-8362
Duane Robertson	DHES-SHWB	444-1430
Randy	City of Helena	447-2455
RANDY HUFFSMITH	Hydrometrics	443-4150
M. K. Bore	"	"
Bill Verwolf	City of Helena	447-8000
Richard Nisbet	" " "	447-8426
Jim Wilber	DHES-SHWB	444-1430

MEMORANDUM

January 24, 1991

TO: Dick Nesbit, Ted Hill, Ralph Smith, Will Selser, Bill Verwolf
FROM: Randy Huffsmith
RE: Helena Landfill Water Quality Monitoring Program

On November 27, 1990, Hydrometrics, Inc. submitted a report to the City of Helena entitled "Hydrogeologic Investigation of the City of Helena Landfill". This report included a proposed groundwater monitoring plan. On December 18, 1990, Hydrometrics, Inc., in conjunction with City of Helena officials, met with the Montana Department of Health and Environmental Sciences, Solid Waste Bureau (MDHES, SWB) and discussed the proposed plan. Several revisions to the monitoring plan were suggested by the Solid Waste Bureau. These revisions included obtaining samples from a smaller network of wells but analyzing those samples for more parameters. No revisions were suggested to the methane monitoring program.

I have enclosed a finalized monitoring plan which is based on input from the SWB and Will Selser of the County Health Department. We can discuss this plan at our meeting scheduled for February 5 at 1:30 pm at the SWB.

kar

Enclosure

RECEIVED

FEB 05 1991

**MONTANA DEPARTMENT OF HEALTH
AND ENVIRONMENTAL SCIENCES
SOLID & HAZARDOUS WASTE BUREAU**

RECEIVED

FEB 02 1991

MONTANA DEPARTMENT OF HEALTH
AND ENVIRONMENTAL SCIENCES
SOLID & HAZARDOUS WASTE BUREAU

HELENA LANDFILL
WATER QUALITY ANALYTICAL SCHEDULE

<u>Well Number</u>	<u>Analysis</u>	<u>Date</u>
83-6	Phase I Parameters	Spring, Fall
HL90-1	Phase I Parameters	Spring, Fall
HL90-2	Phase I Parameters	Spring, Fall
HL90-3	Phase I Parameters	Spring, Fall
40	Phase I Parameters	Spring, Fall
43	Phase I VOC's	Spring, Fall
47	Phase I VOC's	Spring, Fall
13	Phase I VOC's	Spring, Fall
75	Phase I VOC's	Spring, Fall
EPAI	Phase I VOC's	Spring, Fall

RECEIVED

FEB 05 1991

MONTANA DEPARTMENT OF HEALTH
AND ENVIRONMENTAL SCIENCES
SOLID & HAZARDOUS WASTE BUREAU

REPORT OF THE
MONTANA DEPARTMENT OF HEALTH

DATE	PLACE	NAME
1901	Butte	John A. Smith
1902	Butte	John A. Smith
1903	Butte	John A. Smith
1904	Butte	John A. Smith
1905	Butte	John A. Smith
1906	Butte	John A. Smith
1907	Butte	John A. Smith
1908	Butte	John A. Smith
1909	Butte	John A. Smith
1910	Butte	John A. Smith
1911	Butte	John A. Smith
1912	Butte	John A. Smith
1913	Butte	John A. Smith
1914	Butte	John A. Smith
1915	Butte	John A. Smith
1916	Butte	John A. Smith
1917	Butte	John A. Smith
1918	Butte	John A. Smith
1919	Butte	John A. Smith
1920	Butte	John A. Smith

RECEIVED

FEB 02 1921

MONTANA DEPARTMENT OF HEALTH
AND ENVIRONMENTAL SCIENCE
SUIVE & RESEARCH LABORATORY

Notes on point
of Campbell
Issues.

APPLICATION FOR SOLID WASTE MANAGEMENT SYSTEM LICENSE

Name of applicant: City of Helena
Address: Civic Center Helena Montana
Telephone number: 442-9920

This application is for a: ☒ solid waste disposal site, () container site (green box and bulk containers), () transfer station, () resource recovery or processing facility, () other (please specify) _____

Community of Helena, County of Lewis & Clark,
located in South-46 quarter section of Section 19, Township _____,
Range _____. "See Attached Map"

General description of location: South of B.N. mainline, North of Lyndale Ave, East of Carroll College, West of Last Chance Gulch,

Total acreage in site: 38 Usable acreage: 30

Population to be served by solid waste management system: 24,000 +

Will bridges and roads support loaded vehicles? ☒ Yes () No

Is site subject to flooding? () Yes ☒ No

Are natural drainages found within the site? ☒ Yes () No

Depth to groundwater: 30'

Distance from public or private water supplies: 1/4 mile

Are there springs located within one (1) mile of site? () Yes ☒ No

(If "yes", describe proximity to site): _____

City of Helena
Civic Center
405-2222

City of Helena
Civic Center
405-2222

City of Helena
Civic Center
405-2222

City of Helena
Civic Center
405-2222

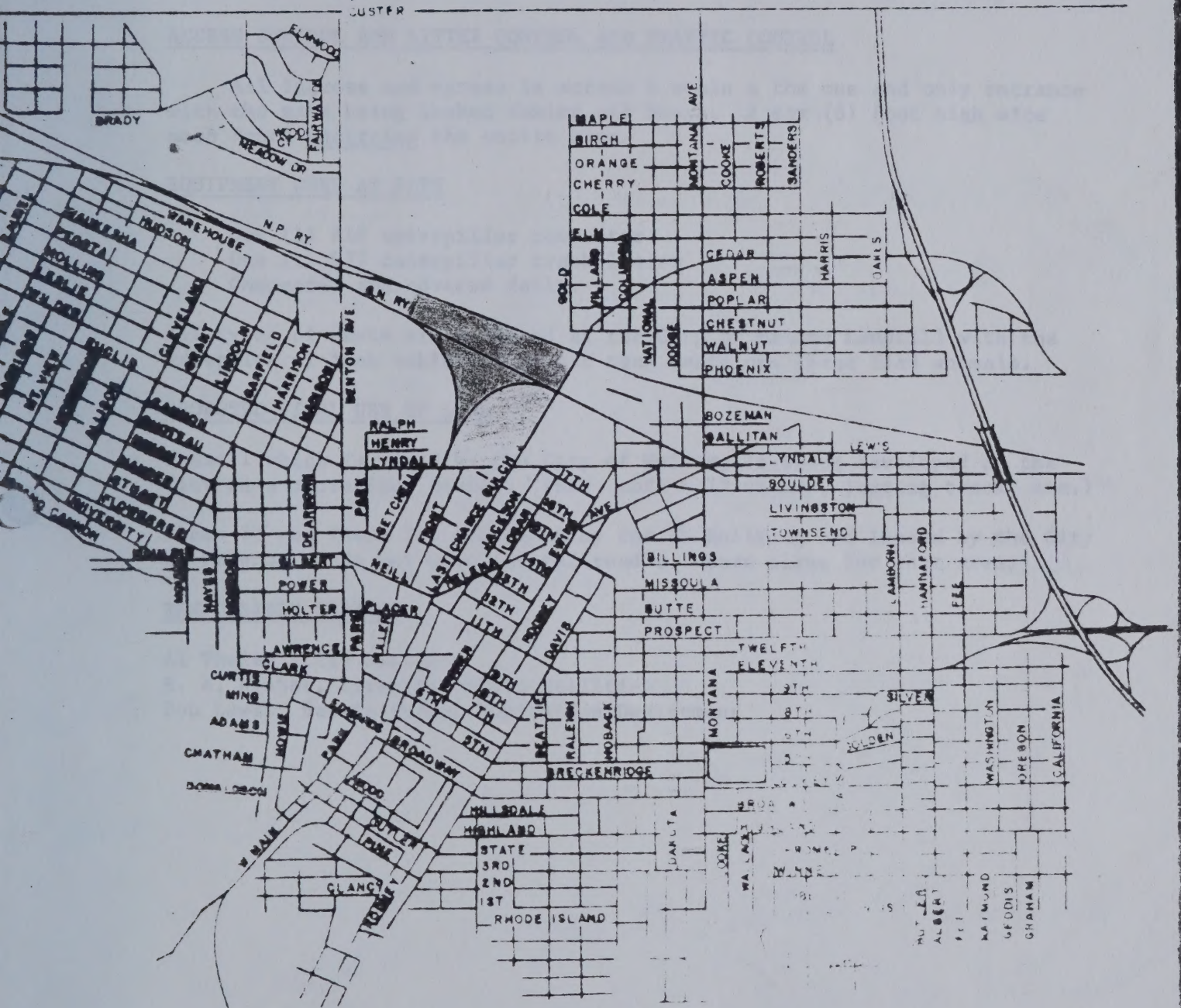
City of Helena
Civic Center
405-2222

City of Helena
Civic Center
405-2222

City of Helena
Civic Center
405-2222

HELENA

8/23/78



— City of Helena Disposal Site



ANNEX

8/22/18



City of Chicago, Illinois

PROPOSED OPERATION & MAINTENANCE PLAN

DAYS AND HOURS SITE OPEN

Closed Sundays

Summer hours November - April 8 a.m. to 5 p.m. Monday - Saturday
Winter hours May - October 9 a.m. to 6 p.m. Monday - Friday 8-5 Sat.

ACCESS CONTROL AND LITTER CONTROL AND TRAFFIC CONTROL

All ingress and egress is across a scale a the one and only entrance with the gate being locked during off hours. A six (6) foot high wire mesh fence encircles the entire area.

EQUIPMENT USED AT SITE

One (1) 816 caterpillar compactor
One (1) 977 caterpillar track loader
Compacted and covered daily.

All types of waste are accepted at the City of Helena Landfill with the exception of junk vehicles, septic tank waste and large dead animals.

PROPOSED FINAL USE OF LAND

Phase I which is owned by the City of Helena, is being developed by the City as a recreation center. (Re: soft ball fields, jogging track, etc.)

Phase II and Phase III are owned by the BN Railroad and leased by the City of Helena. I do not know the railroad's future plans for that area.

RESPONSIBLE PERSONS

Al Thelen, City Manager
R. A. Nisbet, Director Public Utilities
Don Lewis, Suerintendent Sanitation Department

RECOMMENDATION OF THE BOARD

DATE AND HOUR OF MEETING

Monday, January 1, 1912

Meeting held at 8:00 P.M. - 9:15 P.M.
Winter House - 1st Floor - 1st Room

AGENDA

All persons and persons to whom a notice is given to attend the meeting shall be deemed to have been duly notified and shall be deemed to have been present at the meeting.

REPORT OF THE BOARD

The Board has received and considered the report of the Board of Directors and has approved the same.

All persons who are members of the Board of Directors shall be deemed to have been duly notified and shall be deemed to have been present at the meeting.

REPORT OF THE BOARD

The Board has received and considered the report of the Board of Directors and has approved the same. The Board has also received and considered the report of the Board of Directors and has approved the same.

REPORT OF THE BOARD

The Board has received and considered the report of the Board of Directors and has approved the same. The Board has also received and considered the report of the Board of Directors and has approved the same.

All that part of the right of way
of the Burlington No Inc. Railway comp in
the No East Quarter No west Quarter
(NE $\frac{1}{2}$ ~~and~~ NW $\frac{1}{2}$ and in the Northwest
Quarter No East Quarter (NW $\frac{1}{2}$ ~~and~~ NE $\frac{1}{2}$)
of Sec 30, Township 10 North, Range 3
West of the Montana Principal Meridian,
in the City of Helena, County of Lewis &
Clark, State of Montana, located as
shown is hatched red on the Exhibit, "A"

Subject to that certain Easement
dated October 17, 1859 granted by Great
No ~~and~~ Railway Comp.

No. 2 Camp Group
Cattle Corral 17 1829
Lepid to the Cotton Corral
There are hatched red in the Corral,
Class: 200 of 1829, located in
in the Corral, County of Adams,
West of the Mexican Principal Mexican,
of 200, 1829, 10 1829, 10 1829,
Cattle No. 2 Corral (No. 12 1829)
10 1829 10 1829 and in the 1829
the 10 1829 10 1829 10 1829
of the 1829 10 1829 10 1829
All that part of the right of way

Don Lewis
Helena MT

HELENA SOLID WASTES
BETTERMENT PROJECT
ANNUAL REPORT

JULY 1970 - JUNE 1971

FOR

THE CITY OF HELENA

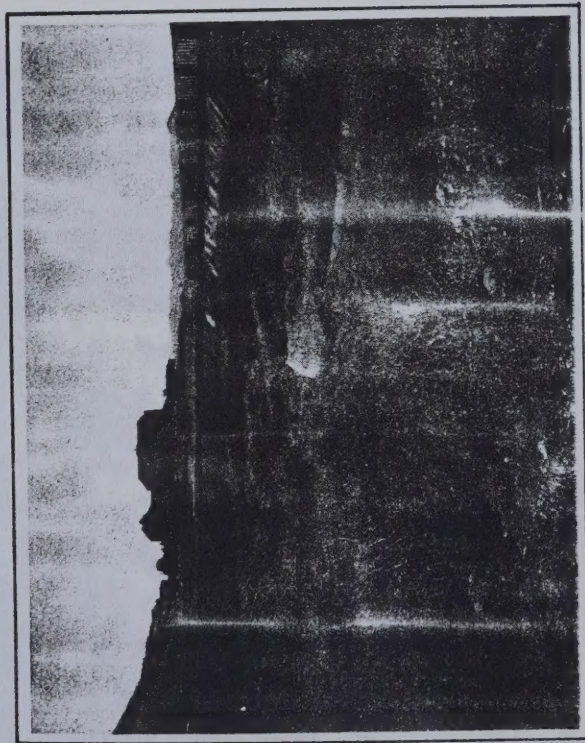
THOMAS, DEAN & HOSKINS INC.
ENGINEERS
GREAT FALLS - BOZEMAN, MONTANA

HELENA

N



NEW SANITARY LANDFILL SITE



Looking west from northeast corner of new landfill site



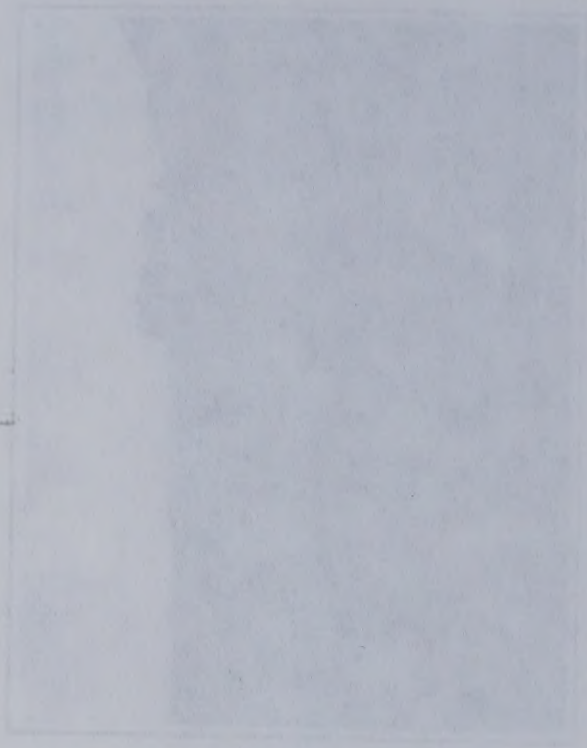
Looking north along centerline of new landfill site



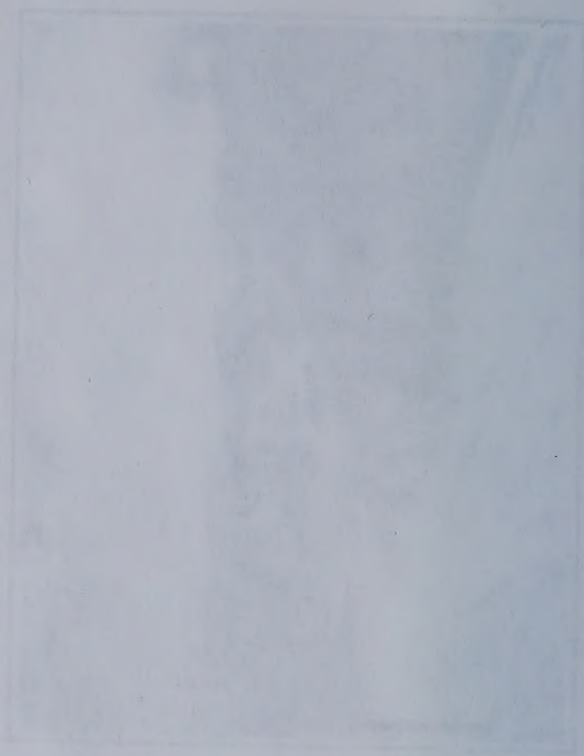
Looking west from northeast corner of new landfill with fill operation in process



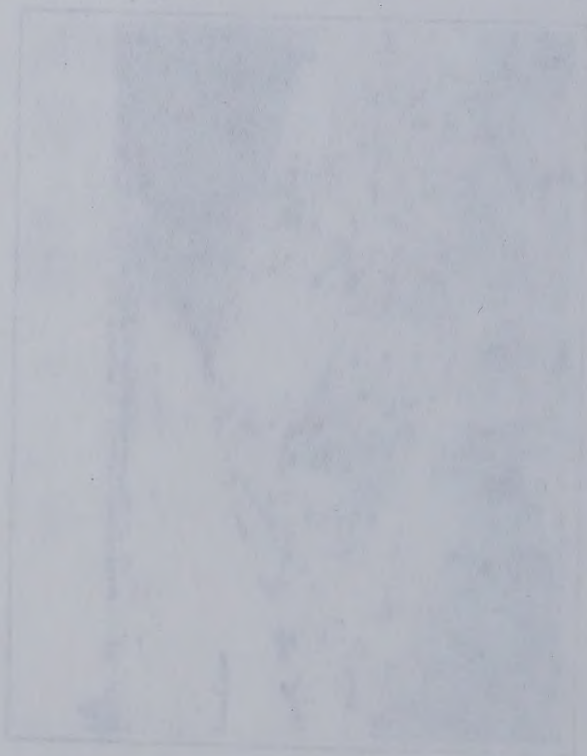
Looking west from northeast corner of new landfill with cover soil over one lift of compacted refuse



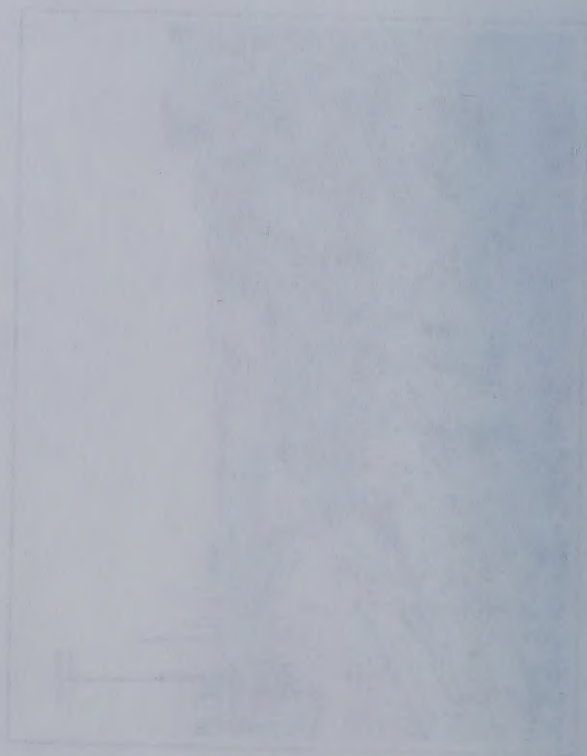
View of the road from the house



View of the road from the house



View of the road from the house



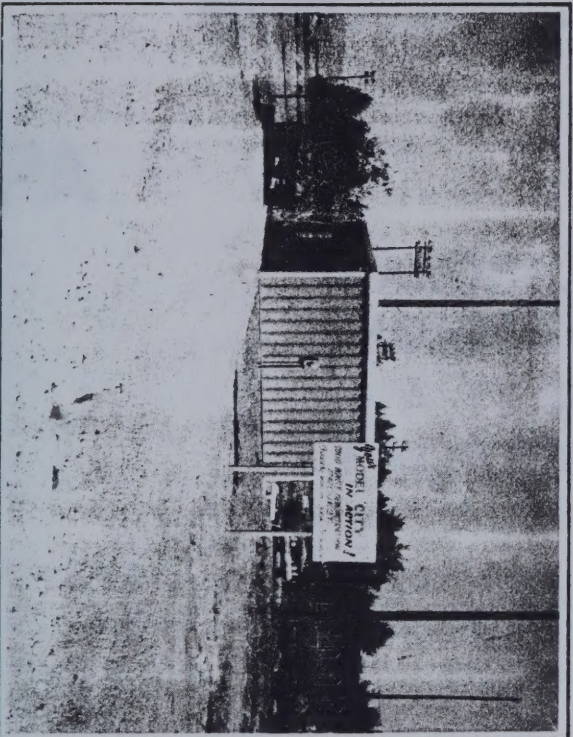
View of the road from the house



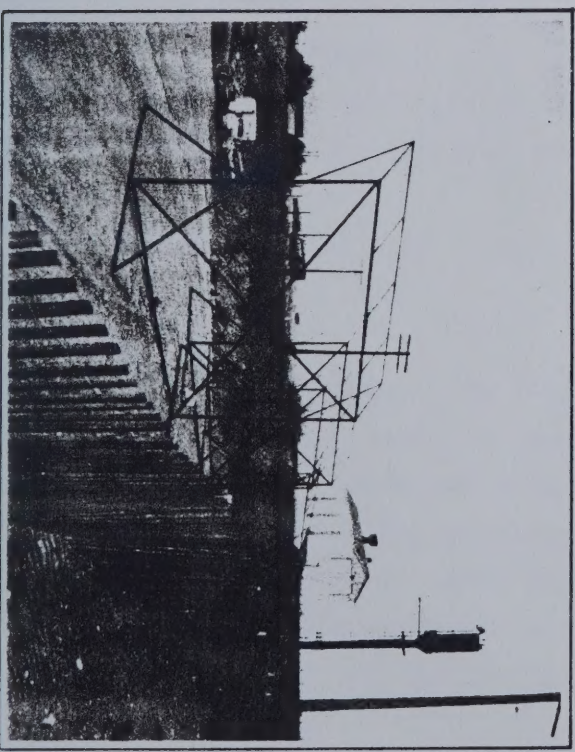
Concrete pipe drain installed through landfill site



Completed clay seal over drain pipe at landfill



New scalehouse and restroom facility at landfill



Portable fence units for controlling blowing papers at new landfill operation



Figure 1: A faint, light blue rectangular area, possibly a placeholder or a very faded image.



Figure 2: A faint, light blue rectangular area, possibly a placeholder or a very faded image.



Figure 3: A faint, light blue rectangular area, possibly a placeholder or a very faded image.



Figure 4: A faint, light blue rectangular area, possibly a placeholder or a very faded image.



LANDFILL GAS AND LEACHATE MONITORING: HELENA, MONTANA - A TECHNICAL ASSISTANCE PANELS PROGRAM REPORT

The landfill is situated within the alluvial valley of Lost Chance Gulch, an intermittent stream which flows through the center of Helena. Lost Chance Gulch has been diverted through a 50-inch concrete conduit beneath the present landfill. Water flows from the conduit and is the building material upon which the landfill rests. The conduit discharges at the northeastern corner of the landfill.

The City of Helena has indicated that other utility lines transect the landfill, including a sanitary sewer which crosses the property from the southwest to the northeast. It appears that this sewer line is below the existing landfill and that service lines from this sewer extend to the YCCA and National Guard Army Ballistics at the eastern edge of the landfill.

The Helena landfill site is being described by dividing it into three distinct areas:

- (1) Inactive Fill Area: The 17-acre inactive fill area, which encompasses the old burning dump, is located on the Lyndale Avenue, west of Lost Chance Gulch. This area was east of the north-south railroad spur. When sanitary landfilling practices were implemented in 1970, inactive areas of the original 17-acre burning dump were filled with wastes. A National Guard inventory and a F.H.C.A. have been held on the burning dump of the old burning dump. The Inactive fill area was completed in June, 1977.

SEPA

LANDFILL GAS AND LEACHATE
MONITORING: HELENA, MONTANA
- A TECHNICAL ASSISTANCE PANEL
PROGRAM REPORT

III. STUDY AREA DESCRIPTION

Helena Landfill Site

The City of Helena landfill is situated northwest of the roadway intersection of Lyndale Avenue and Last Chance Gulch Street in the central part of the city. The site is bounded on the west by a small ridge upon which Carroll College buildings are located and on the north by the Burlington Northern Railroad tracks. The site is owned by the Burlington Northern Railroad and is leased to the City. Figure 5 depicts a layout of the site.

The landfill is situated within the alluvial valley of Last Chance Gulch, an intermittent stream which flows through the center of Helena. Last Chance Gulch has been diverted through a 60-inch concrete conduit beneath the present landfill. Water flows both in the conduit and in the bedding material upon which the conduit rests. The conduit presently discharges at the northwestern border of the landfill.

The City of Helena has indicated that other utility lines transect the landfill, including a sanitary sewer which crosses the property from the southwest to the northeast. It appears that this sewer line is below the existing landfill and that service lines from this sewer extend to the YMCA and National Guard Armory buildings on the eastern edge of the landfill.

The Helena landfill site is best described by dividing it into three distinct areas:

- (1) Inactive Fill Area: The 17-acre inactive fill area, which encompasses the old burning dump, is located north of Lyndale Avenue, west of Last Chance Gulch Street and east of the north-south railroad spur. When sanitary landfilling practices were implemented in 1970, twelve acres of the original 17 acre burning dump were filled with wastes. A National Guard Armory and a Y.M.C.A. have been built on the remaining acreage of the old burning dump. The inactive fill area was completed in June, 1977.

Ship - 1000/11 212

The City of Helena is situated on the left bank of the river, about 10 miles above the mouth of the river. The city is bounded on the west by a small ridge upon which stands the old fort. The city is bounded on the east by the river. The city is bounded on the south by the river. The city is bounded on the north by the river. The city is bounded on the west by a small ridge upon which stands the old fort. The city is bounded on the east by the river. The city is bounded on the south by the river. The city is bounded on the north by the river.

The river is situated about 10 miles above the mouth of the river. The river is situated about 10 miles above the mouth of the river. The river is situated about 10 miles above the mouth of the river. The river is situated about 10 miles above the mouth of the river. The river is situated about 10 miles above the mouth of the river. The river is situated about 10 miles above the mouth of the river. The river is situated about 10 miles above the mouth of the river. The river is situated about 10 miles above the mouth of the river. The river is situated about 10 miles above the mouth of the river. The river is situated about 10 miles above the mouth of the river.

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(1) Industrial Area: The 17-acre industrial area is situated on the left bank of the river, about 10 miles above the mouth of the river. The area is bounded on the west by a small ridge upon which stands the old fort. The area is bounded on the east by the river. The area is bounded on the south by the river. The area is bounded on the north by the river. The area is bounded on the west by a small ridge upon which stands the old fort. The area is bounded on the east by the river. The area is bounded on the south by the river. The area is bounded on the north by the river.

Approximate Scale 1"=200'

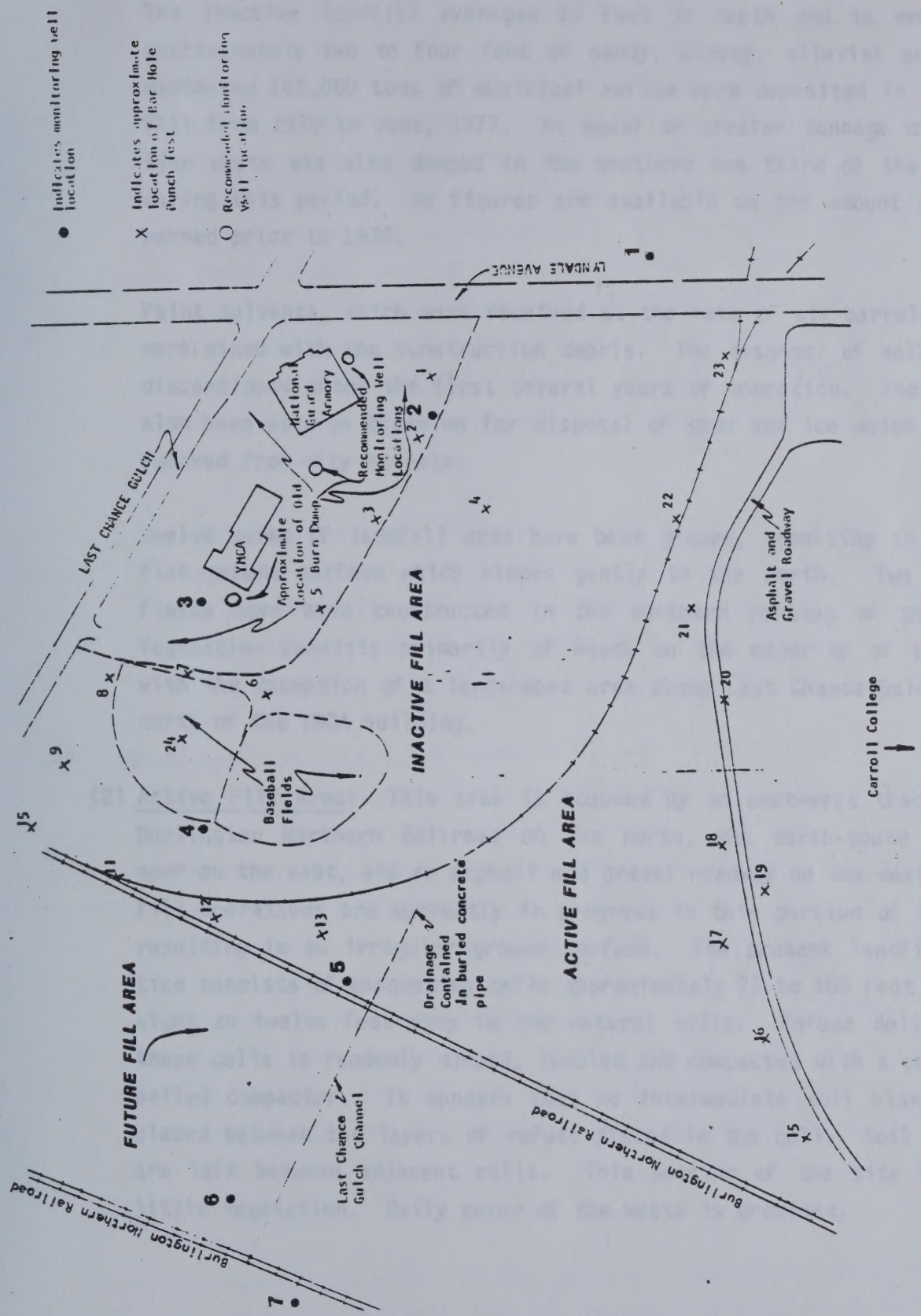


FIGURE 5. THE HELENA LANDFILL SITE SHOWING BARHOLE PUNCH TEST AND MONITORING WELL LOCATIONS

The inactive landfill averages 25 feet in depth and is overlain by approximately two to four feet of sandy, clayey, alluvial soils. An estimated 162,000 tons of municipal refuse were deposited in the landfill from 1970 to June, 1977. An equal or greater tonnage of demolition waste was also dumped in the southern one third of the landfill during this period. No figures are available on the amount of wastes burned prior to 1970.

Paint solvents, which were received at the rate of six barrels a week, were mixed with the construction debris. The disposal of solvents was discontinued after the first several years of operation. The site has also been used on occasion for disposal of snow and ice which had been removed from city streets.

Twelve acres of landfill area have been graded, resulting in a fairly flat ground surface which slopes gently to the north. Two baseball fields have been constructed in the northern portion of this area. Vegetation consists primarily of weeds on the majority of this site with the exception of a landscaped area along Last Chance Gulch Street north of the YMCA building.

- (2) **Active Fill Area:** This area is bounded by an east-west track of the Burlington Northern Railroad on the north, the north-south railroad spur on the east, and an asphalt and gravel roadway on the west. Landfill operations are currently in progress in this portion of the site, resulting in an irregular ground surface. The present landfill practice consists of excavating cells approximately 75 to 100 feet wide and eight to twelve feet deep in the natural soils. Refuse delivered to these cells is randomly dumped, leveled and compacted with a self-propelled compactor. It appears that no intermediate soil blankets are placed between the layers of refuse placed in the cell. Soil barriers are left between adjacent cells. This portion of the site has very little vegetation. Daily cover of the waste is provided.

The respective landfill managers 22 years in 1972 and is estimated by approximately one to four tons of waste, largely, untreated refuse. As estimated 100,000 tons of untreated refuse were deposited in the landfill from 1970 to June, 1977. In 1977, the landfill manager at that time was also located in the southern end of the landfill during this period. No figures are available as to the amount of waste burned prior to 1970.

Partial solutions, which were received at the rate of six barrels a week, were placed with the construction debris. The disposal of refuse was discontinued when the first barrel failed to operate. The site has also been used as a location for disposal of some and the which has been burned since 1970.

Twelve acres of landfill area have been graded, resulting in a fairly flat ground surface which slopes gently to the north. The landfill is also being constructed in the northern portion of the site. Vegetation consists primarily of weeds on the majority of the site with the exception of a landscaped area along the London Ontario Street north of the WMA building.

12) Acrylic Filler Area: This area is bounded by an east-west fence of the Burlington Northern Railroad on the north, the north-south railroad spur on the east, and an asphalt and gravel roadway on the west. Landfill operations are currently in progress in this portion of the site, resulting in an irregular ground surface. The present landfill grade consists of excavated cells approximately 75 to 100 feet wide and about 10 feet high in the central cells. Refuse delivered to these cells is randomly dumped, leveled and compacted with a self-propelled compactor. It appears that no immediate soil drainage will occur between the layers of refuse placed in the cell. Soil between the left boundary adjacent cells. This portion of the site has very little vegetation. Daily cover of the waste is provided.

Access to the site is limited to six days per week, Monday through Saturday. The site has a gatehouse with scales and all vehicles are weighed to determine the quantity of waste received at the site. Approximately 30,000 tons of waste are received at the site annually and it is estimated that in January 1982, the expected closing date of this portion, 159,000 tons of municipal refuse will have been deposited. The majority of these wastes are generated within the city limits of Helena. No user fee is assessed to city residents; rather, an annual collection assessment is charged. Citizens or commercial establishments which are not assessed collection fees must pay a user fee at the gate.

Four persons are employed at the landfill - a gate keeper, two equipment operators, and a laborer. The site is maintained primarily by a bulldozer and a landfill compactor. A scraper is also available for excavating trenches and stockpiling cover material. The landfill is in full compliance with all local, State, and Federal standards.

- (3) Future Fill Area: The future fill area is located west of Last Chance Gulch Street and between the two east-west Burlington Northern Railroad tracks. This area is expected to have an 18-year life beginning in January, 1982 with an average annual waste load of 35,000 tons per year. It is approximately 20 to 25 feet lower than the landfill mass to the south. The ground surface slopes gently down to the north with a maximum difference in elevation on the order of 5 to 10 feet. In this area, Last Chance Gulch leaves the 60-concrete conduit beneath the landfill, and returns to its natural channel. The channel had a moderate amount of flow at the time of the study. Vegetation consists of grasses, weeds and numerous deciduous trees along the drainage way.

Landfill Site Geology

An independent assessment of the geological and geotechnical data associated with the Helena landfill site was beyond the scope of this study. Site geology information, which follows, was obtained from a memo prepared by Mr. Kenneth L. Waesche, geologist for the State of Colorado Department of Health

Access to the site is limited to one day per week, Monday through Saturday. The site has a gatehouse with scales and all vehicles are weighed in determining the quantity of waste received at the site. Approximately 30,000 tons of waste are received at the site annually and it is estimated that in January 1992, the expected closing date of this portion, 150,000 tons of material waste will have been received. The majority of these wastes are generated within the city limits of the region. The waste fee is assessed on city residents; however, an annual collection assessment is charged. (Exemptions or commercial establishments which are not assessed collection fees must pay a user fee at the site.)

Four sections are highlighted at the landfill - a gate house, the equipment operations, and a lab area. The site is maintained primarily by a city worker and a landfill contractor. A contract is also available for scavenging, leachate and stockpiling cover material. The landfill is to full compliance with all local, state, and federal standards.

(a) Future Cell Areas: The future cell area is located west of Cell One and south of the existing cell. The two east-west Washington Northern Railroad tracks. This area is expected to have an 18-year life beginning in January, 1992 with an average annual waste load of 25,000 tons per year. It is approximately 10 to 12 feet lower than the landfill base to the south. The ground surface slopes gently down to the north with a maximum difference in elevation on the order of 5 to 10 feet. In this area, Cell One's leachate leaves the cell through a central beneath the landfill, and returns to the natural channel. The channel has a moderate amount of flow at the time of the study. Vegetation consists of grasses, weeds and numerous shrubs along the drainage way.

Landfill Site Geology

An independent assessment of the geological and geotechnical data associated with the future landfill site was beyond the scope of this study. Site geologic information, which includes the data and a map prepared by Mr. Richard J. Mescher, geologist for the State of Colorado Department of Health

Approximately a 20 acre parcel
in the N $\frac{1}{2}$ of the NW $\frac{1}{4}$ Section 30,
Township 10, Range 3,

Approximately a 20 acre parcel
in the NW 1/4 of the NW 1/4 Section 30
Township 10, Range 3.

RECEIVED**UNITED STATES DEPARTMENT OF AGRICULTURE**

SEP 20 1976

SOIL CONSERVATION SERVICE

P. O. Box 970, Bozeman, Montana 59715

**CITY of HELENA
ENGINEER**

SUBJECT: EVT--Pollution and Waste Management Report
Helena Sanitary Landfill Expansion site Evaluation
Sec. 19 & 30, T10N, R3W

DATE: 9/9/76

TO: Arnold E. Quale
District Conservationist
Soil Conservation Service
Helena, Montana

As requested by the city of Helena, an investigation and evaluation of their proposed sanitary landfill expansion was made during August, 1976. Don Coffman, Ground Water Hydrologist, USGS, Helena, was consulted.

The site should not be used for the disposal of Group I (toxic, etc) wastes. The site is considered suitable for Group II wastes if ground water separation is maintained and surface water control measures are taken as recommended. There is a low pollution potential to surface waters and a moderate pollution potential to several nearby wells. These wells are not critical supplies and could be converted to city water service.

Water passing through buried refuse leaches out contaminants. This "leachate" may drastically alter the quality of surface and ground waters. Sanitary landfill siting and operations should minimize the amount of water that can reach the refuse and should provide for the control or attenuation of any leachate produced.

Site Evaluation

The existing landfill is located on the lower end of Last Chance Gulch where it begins to merge with the Helena Valley. The proposed expansion area is adjacent, north and north-northeast of the existing landfill. See Sketch Attachment 1.

Geology: Stratigraphically the site is underlain by the Helena Limestone of Precambrian Age. The Helena Limestone is predominately a gray, argillaceous limestone which weathers to a light brown or yellow. Locally, the limestone is very dolomitic. The limestone or dolomite can be seen out-cropping in several roadcuts above the landfill.

Overlying the Helena Limestone are thick deposits of alluvial-colluvial origin. These materials have been deposited at the mouth of Last Chance Gulch as fan debris and stream depositing alluvium. These coarser deposits of sand, gravel, and cobbles have been dredged at sometime in the past for the gold they contained. Apparently the dredging operation went down to a clay lens which carried the gold. The resulting tailings



Mr. J. B. Smith
Director, Department of
Public Works
City of Wilmington
Delaware
Wilmington, Delaware

As requested by the City of Wilmington, an investigation was conducted of
the proposed sanitary landfill expansion project located at the
intersection of the Delaware and Maryland State Highways, near the
intersection of the City of Wilmington and the State of Delaware.
The site is located on the east side of the Delaware River, near the
intersection of the Delaware and Maryland State Highways. The site is
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near the intersection of the Delaware and Maryland State Highways.

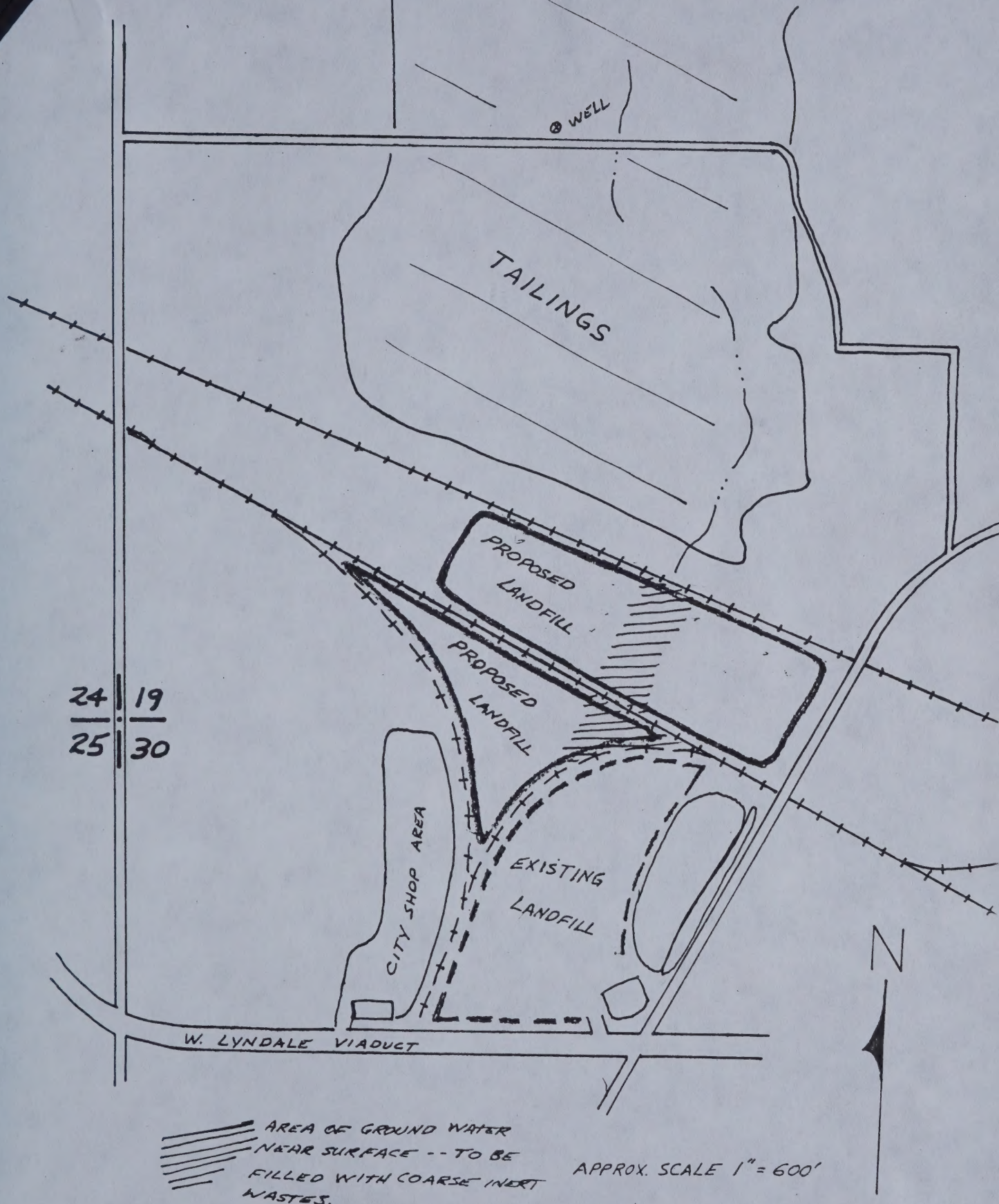
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2.0 Description

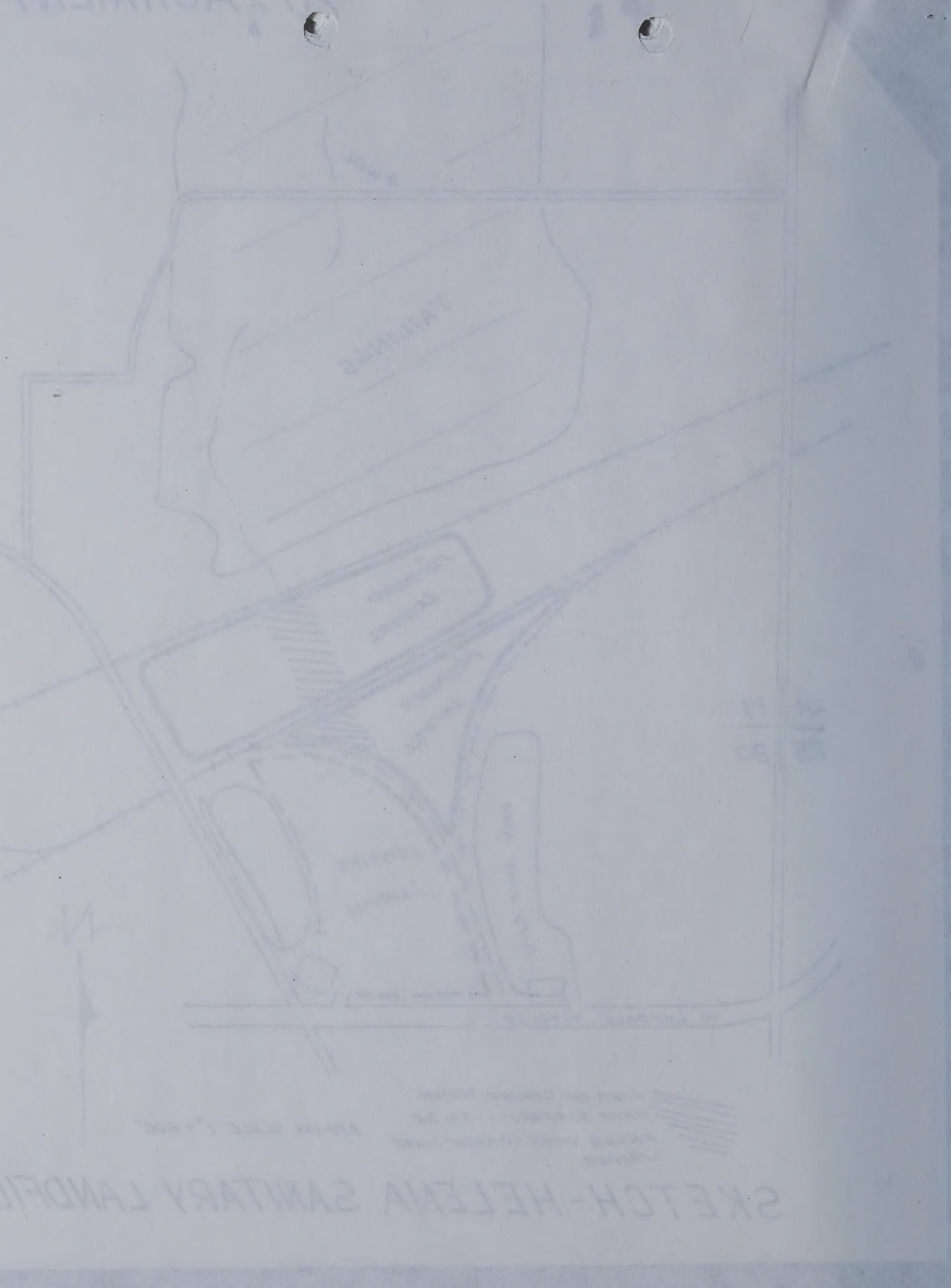
The proposed sanitary landfill is located on the east side of the
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Geological data indicates that the site is composed of the following
materials: sand, silt, and clay. The site is located on the east
side of the Delaware River, near the intersection of the Delaware and
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Highways. The site is located on the east side of the Delaware River,
near the intersection of the Delaware and Maryland State Highways.

During the field investigation, the following observations were made:
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intersection of the Delaware and Maryland State Highways. The site is
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SKETCH-HELENA SANITARY LANDFILL



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SKETCH-HELENA SANITARY LANDFILL